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DATE: June 1982

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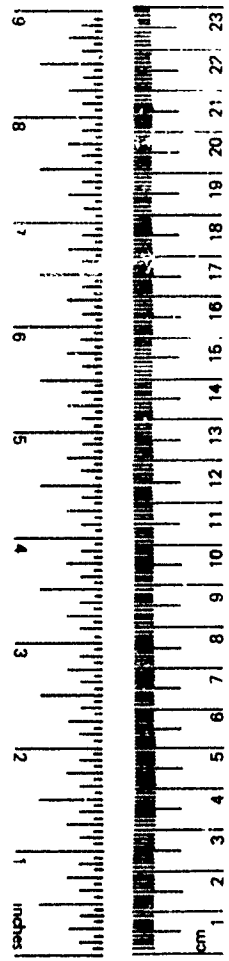
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

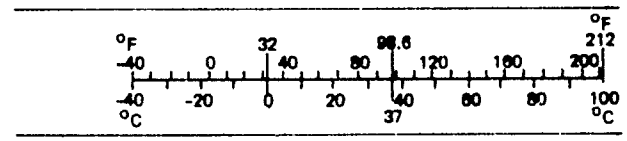
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2 5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0 9	meters	m
mi	miles	1 6	kilometer	km
		AREA		
in^2	square inches	6 5	square centimeters	cm^2
ft^2	square feet	0 09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2 6	square kilometers	km^2
	acres	0 4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0 45	kilograms	kg
	short tons (2,000 lb)	0 9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0 24	liters	l
pt	pints	0 47	liters	l
qt	quarts	0 95	liters	l
gal	gallons	3 8	liters	l
ft^3	cubic feet	0 03	cubic meters	m^3
yd^3	cubic yards	0 76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2 54 (exactly) For other exact conversions and more detailed tables, see NBS Misc Publ 286 Units of Weights and Measures, Price $2 25, SD Catalog No C13 10 286



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0 04	inches	in
cm	centimeters	0 4	inches	in
m	meters	3 3	feet	ft
m	meters	1 1	yards	yd
km	kilometers	0 6	miles	mi
		AREA		
cm^2	square centimeters	0 16	square inches	in^2
m^2	square meters	1 2	square yards	yd^2
km^2	square kilometers	0 4	square miles	mi^2
ha	hectares (10,000 m^2)	2 5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2 2	pounds	lb
t	tonnes (1,000 kg)	1 1	short tons	
		VOLUME		
ml	milliliters	0 03	fluid ounces	fl oz
l	liters	2 1	pints	pt
l	liters	1 06	quarts	qt
l	liters	0 26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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7 OCT 1982

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19 KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides the results of conventional temporary and permanent mooring anchor tests in dense fine sand at Port Hueneme and normally consolidated silty clay at Indian Island. It includes a preliminary analysis of the data, and provides suggested modifications to improve anchor performance. The data provided can be used to quantify anchor capacity, to guide anchor selection, to improve the understanding of anchor behavior, and to guide the formulation of empirically and theoretically founded schemes to define

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20. Continued

anchoring capacity. Although the number of tests performed on each anchor during the recent anchor tests in sand and mud was limited, the repeatability of the data was excellent and correlations with previous NCEL tests provided added insight into the specific behavior of the tested anchors and into general anchor and chain behavior. Data for the Two-Fluke Balanced, STATO, MOORFAST, BRUCE Twin-Shank, STEVFIX, PRISMA, and WISHBONE anchors are presented principally as plots of anchor penetration, holding capacity, and shank pitch and roll as functions of anchor drag distance.

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TN-1635 89 pp illus June 1982 Unclassified

1. Anchors 2. Holding capacity I. YF60.536.091.01.A203

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CONTENTS

INTRODUCTION

Tests of a variety of conventional drag-embedment anchors have been conducted in sand at Port Hueneme, CA and in mud at Indian Island, WA. These tests were performed to evaluate the performance and suitability of several Navy and commercial anchors and to provide data to enable anchor selection for various applications.

The tests were sponsored by the Naval Sea Systems Command (NAVSEA) and the Naval Facilities Engineering Command (NAVFAC). Specific purposes of the overall test program were:

1. To define the performance of the Two-Fluke Balanced Anchor currently in use on some Navy submarines.

2. To define the performance of the MOORFAST Anchor, currently in use on the Navy TATF.

3. To provide comparative performance data for the Navy STATO and MOORFAST anchors in sand to guide anchor selection for the McCann Submarine Rescue Chamber mooring system.

4. To provide performance data for selected high efficiency anchors that could satisfy the requirements for higher capacity Navy fleet moorings.

This report briefly describes the test procedures employed at Port Hueneme and Indian Island, provides data plots of each anchor test, and includes a preliminary analysis of the data.

These data and data from previous test programs conducted for NAVFAC and NAVSEA (Ref 1 through 4) are being more thoroughly analyzed under an ongoing program to develop procedures to predict anchor holding capacity as a function of seafloor engineering properties.

TEST PROGRAM

Locations

Port Hueneme. The seafloor material at this site consisted of a poorly graded dense sand (SP classification) with an approximate bulk wet density of 130 lb/ft^3. Grain size curves for samples recovered with a diver held core sampler are provided by Figure 1.

Indian Island. Previous anchor tests (Ref 1, 2, 4) had been conducted at this site in Puget Sound, Washington. The site was selected for this series of tests because site surveys and soil analysis data were available, considerable anchor test data were available for comparison, and floating support was again available from the Washington State Army National Guard. The seafloor soil is a normally consolidated

organic silty clay of high plasticity. The soil shear strength increases almost linearly from 0 at the surface to 1-1/2 psi at 22 feet or about 10 psf/ft of depth. The strength profile is plotted as Figure 2. Figure 3 presents the grain size curve which shows almost equal distribution between silt and clay size particles.

Anchors

The following anchors were tested:

Location	Anchor	Nominal Weight, lb (kg)
Port Hueneme		
	Two-Fluke Balanced	8,000
	MOORFAST	3,000; 6,000
	STATO	3,000
	BRUCE Twin-Shank	(500)
Indian Island		
	Two-Fluke Balanced	8,000
	MOORFAST	6,000
	BRUCE Twin-Shank	(500)
	PRISMA with Cutter	1,895
	STEVFIX	(5,000)
	WISHBONE	25; 60

Appendix A provides dimensions of all tested anchors.

The 8,000-pound Two-Fluke Balanced Anchor was tested both with and without ball guide. This anchor was developed by the British Admiralty and was designated the AC (Admiralty Cast) submarine anchor. The anchor with its ball guide is shown in Figure 4. The ball guide, which weighs 1,800 pounds, is needed for proper anchor storage in the submarine hull. The ball guide carries a spigot which is arranged to correctly orient the anchor just before its entry into the hull. The anchor is pulled until the anchor crown is flush with the hull. The ball guide adds considerably to the anchor weight and undoubtedly reduces the penetrability of the anchor. For other than submarine applications, the ball guide may not be needed; thus, it was tested both with and without the ball guide.

The MOORFAST anchor (Figure 5) is being used and is proposed for use by the Navy for various other applications. The MOORFAST is similar in appearance to the STATO, but for equal weights, the MOORFAST anchor has about half the STATO's fluke area. MOORFAST anchor performance is advertised as similar to the STATO; however, with the large differences in size, this would be unlikely. Two sizes of MOORFAST (3,000 and 6,000 pounds) were provided by BALDT, Inc., for trials in sand and mud seafloors.

A 3,000-pound STATO was tested to evaluate the effects of a stabilizer modification on performance. For a possible application in the Submarine Chamber Rescue System (Ref 5), the anchor may be free-fall

deployed. The standard, tapered, folding stabilizers shown in Figure 6a would probably not survive free fall. The STATO in Figure 6b was modified to accept a clamped-on 5-inch OD tube. Both the standard-tapered and pipe stabilizers provided an extended anchor width of 12 feet. In addition, the STATO fluke angle was reduced to 32 degrees in accordance with the results of previous tests in sand (Ref 2). The sand tests are described herein; tests in mud are described in Reference 3.

The three anchors tested for possible application with high capacity Navy fleet moorings were the BRUCE Twin-Shank, PRISMA, and the STEVFIX. The 500 kg BRUCE Twin-Shank with adjustable fluke angle shown in (Figure 7) was tested previously in coral sand at Guam (Ref 3) and a 340-kg BRUCE Twin-Shank with fixed fluke was tested in mud at Indian Island (Ref 1). The PRISMA anchor is a new adjustable fluke mooring anchor manufactured by Vrijhof Anchors. It was designed to be control-lowered to the seafloor and to achieve deep penetration because of its streamlined shape. The twin shank, hollow fluke design provides a large fluke area per unit weight. The PRISMA anchor shown in Figure 8 was provided with a cutter to allow deeper penetration and recovery by chain chaser. The anchor alone weighed 1,420 pounds and with cutter weighed 1,875 pounds. A 5,000-kg STEVFIX was also provided by Vrijhof for testing (Figure 9 shows a smaller version of the STEVFIX). Two small boat WISHBONE anchors (25- and 60-pound nominal weights) were provided by NAVSEA for testing in mud. As shown in Figure 10, these anchors were quite small and required a different testing procedure than for the larger ship anchors.

TEST PROCEDURES AND EQUIPMENT

The test setup used at Port Hueneme is shown schematically by Figure 11. A slightly different setup was used at Indian Island. At Indian Island the test mooring leg was comprised only of 2- and 3-inch chain, and the back anchor was a 300K propellant-embedded anchor fluke (not a 9,000-pound STATO anchor as shown in Figure 11).

Each anchor tested was instrumented to determine anchor depth, anchor shank pitch, anchor roll, and anchor load (see Figure 12). The load cell is the slender object attached between the end of the shank and the mooring chain. The instrument package is located on the shank and contains a pressure transducer to measure anchor depth, inclinometers to measure shank pitch and anchor roll, all signal conditioning equipment, and the load cell amplifiers. A hose attached to the pressure transducer was buoyed off to ensure that its bitter end remained in the water column to prevent false depth readings. The anchor measurement system was connected to the instrument shack onboard the YC barge via a 1,000-foot-long, six-conductor electrical cable. Mooring line load and mooring line angle at the barge and barge displacement relative to a fixed spar buoy were also recorded. These data are needed to calculate true anchor drag distance as well as to determine the contribution of the bottom resting chain to mooring capacity.

Anchor loading was accomplished by a 100-ton hydraulic cable puller that pulled the YC test barge toward the restraint mooring anchor. The test anchor was pulled at about 2 ft/min to peak load, until the anchor

became unstable or until anchor load reached 110,000 pounds in mud at Indian Island. Above 110,000 pounds the barge crane could not break the anchor out of the mud seafloor. In sand, breakout loads were small, typically less than 30% of anchor load, thus anchor stability controlled test termination.

The test procedures used have evolved during a 3-year period. In general, the data recovery rate has improved, but problems still occurred with the depth measurements, particularly at Indian Island where good depth data was recovered in only 2 (note tests 5 and 12, Appendix C) out of 10 tests. The pressure transducer line continually became kinked or blocked with mud. Final anchor depth was recorded for one other test (note test 2, Appendix C) after the pressure hose apparently became unkinked.

At Port Hueneme, depth measurements were recorded; however, a few seem questionable (note tests 6 and 7 of Appendix B where the shank tip moved above the seafloor). The seafloor did have an average slope of 1:50; and this could have varied locally, causing some of the sudden anchor depth changes that were recorded. The depths are referenced to an initial value taken by depth recorder and by leadline for backup. A 1:50 slope line is drawn on each test plot in Appendix B to provide a better reference for anchor depths.

The test procedure and equipment for the WISHBONE anchors were substantially different than for the larger ships' anchors. Total deck load was the only measurement taken during testing. A 100-foot length of 3/8-inch wire was placed between the anchor and the 1-inch winch wire to ensure that embedment was not inhibited. The test anchor was pulled away from the test barge by a small boat and lowered to the seafloor. Sufficient wire was pulled off the winch drum to prevent any uplift of the anchor shank at peak load. A minimum 8:1 scope was used. Each anchor was pulled at about 10 ft/min to peak load. Only two tests could be performed with each anchor because of time constraints.

PORT HUENEME TEST RESULTS

Chain

Chain resistance was approximately measured during each anchor test. Just prior to the anchor's being loaded, measured deck load is totally attributed to chain resistance. Chain efficiency (based on in-water weight) determined for each anchor test varied from about 0.95 to 1.8 with an average value of 1.4. Large variations were also noted at San Diego and Guam (Ref 1, 2, 3) and could be due to seafloor surface density and strength variations, chain leg straightness, and to some uncertainty as to when the anchor was first loaded. In addition to the combined anchor/chain tests, the chain leg alone was pulled while total deck load and line angle were recorded. The static chain efficiency based on in-water weight was 1.88. With drag, efficiency decreased to as little as 1.27 and averaged 1.4. The chain was left overnight and pulled the next morning. Static efficiency was 1.7; efficiency again decreased to an average of 1.4 during drag. It is clear that there is no unique chain efficiency for Port Hueneme sand or, undoubtedly, for other sands. The maximum efficiency recorded during the chain test was

comparable to the chain efficiency determined from the first anchor test conducted each morning. Calculations of anchoring efficiency, which include the resistances of anchor and buried chain but excludes the chain lying on the seafloor, assumed a chain efficiency of 1.4. Use of the lowest recorded efficiency of 1.27 would have resulted in higher estimates of anchoring efficiency. Results are shown in Table 1 for all Port Hueneme tests.

The substantial effect of chain on total anchoring resistance was noted previously (Ref 1 through 4). This effect is illustrated in Figure 13 where total load at the deck is plotted against load at the anchor. The difference in load is attributed to chain on and in the seafloor. The interesting feature of the plot is that the data for Port Hueneme sand, San Diego sand, and Guam coral sand all plot within the same general scatter band even though the weight of chain on the sea floor during tests and the anchor types and weights were substantially different.

All Port Hueneme data are plotted while only a few typical tests from San Diego and Guam are plotted. All the tests from Guam and San Diego fell within the same range.

The right side of Figure 13 lists approximate chain weights for the three sites as a function of total load. Referenced to the plotted 45-degree line, its apparent that the chain resistance increases with anchor load even though chain weight on and in the seafloor decreases. This indicates that the resistance of that portion of the chain that is buried by the downward force of the anchor shank is substantially greater than would be anticipated, based upon simple chain drag tests. For example, at about 70 kips total load, 3,000 pounds of chain at San Diego produced 30,000 pounds of resistance, 5,000 pounds at Guam produced 25,000 pounds, and 13,000 pounds at Port Hueneme produced 28,000 pounds. Chain resistances are comparable, yet weight of chain in contact with the seafloor varied by more than a factor of 4.

At first glance, the data scatter of Figure 13 seems large; however, the scatter is reduced considerably when the resistance of the chain on the seafloor is subtracted from the total load to get anchoring load. Chain resistance is determined by multiplying the calculated weight of chain lying on the seafloor by the average measured chain efficiency at that site. Maximum effective anchoring load is shown encircled for the various tests plotted. The lower limit of anchoring load (anchor and buried chain) versus anchor load is described approximately by anchoring load = 1.28 anchor load. Stated another way, the chain seems to hold about 20% of the total anchoring load. This simplified relationship was checked against San Diego tests to total loads of 140,000 pounds, and it remained valid. This relationship is being evaluated further before it is incorporated into any empirical predictive scheme. Data from ongoing model tests and a more thorough analysis of the field test data will enhance the understanding of the chain effect.

Performance of Anchors

Performance data for the 15 anchor tests in sand are summarized in Table 1. Principal items listed in the table are the efficiency of the anchor alone (load at the anchor/anchor weight) and the anchoring efficiency (anchoring load/anchor weight). Performance of the various

anchors tested is described in more detail in the following paragraphs. All reduced test data, in the form of data listings and data plots, are provided in Appendix B.

Two-Fluke Balanced Anchor. Test results for the 8,000-pound Balanced anchor with and without ball guide are presented in Figures 14 and 15, respectively, and then combined in Figure 16. The duplication of results for each series of tests was excellent. The total horizontal component of mooring load and the load at the anchor are plotted versus true anchor drag distance. The large and consistently increasing contribution of the chain to total mooring load is indicated by the vertical distance between total and anchor load curves. Data for the two tests of the Balanced anchor without ball guide (Figure 15) were recorded for only 20 feet of drag when linearity problems occurred with the instrumentation. Unfortunately, this was not noted at the time. However, based upon the shapes of the curves, the ultimate capacity of the anchor was being approached.

As shown in Figure 16, the behavior of the Balanced anchor with and without ball guide is similar. Maximum anchor capacity is achieved in 30 to 40 feet of drag and is about 50,000 pounds for the anchor with ball guide and is projected to be similar for the anchor without ball guide. The interesting difference in the curves is that the chain effect appears to be greater for the anchor without ball guide. The ball guide minimizes the ability of the anchor to depress the chain into the seafloor and thus increase the frictional resistance of the chain. Although anchor behavior was similar and total mooring loads are approximately similar, the holding efficiencies, as recorded in Table 1, are not similar because of the high added weight of the ball guide. Efficiencies based on total weight averaged 8.6 for the anchor without ball guide and 6.4 for the anchor with ball guide. Based upon the expected increase in anchor load to about 50,000 pounds, projected maximum efficiency for the anchor without ball guide would approach 10 in sand. Based on nominal weight of 8,000 pounds for the anchor with ball guide, efficiency was 7.9. The Balanced anchor (AC-17) was tested by the British Admiralty (Ref 6) in a mixture of sand, shingle, and clay. Average anchoring efficiency for the anchor without ball guide was 8.5, which agrees well with the recent NCEL test results.

In sand the Balanced anchor was stable with drag, developed holding capacity rapidly, and achieved approximately the same ultimate capacities with and without ball guide. However, where in-hull stowage is not a requirement, the ball guide contributes to weight and anchoring efficiency penalties and should not be used.

MOORFAST Anchor. Results for the 3K and 6K MOORFAST anchors are presented in Figures 17 and 18. Total horizontal mooring load, anchor load (3K anchor only), and anchor rotation are plotted versus anchor drag resistance. The 3K test results are almost identical. The anchor began to roll at about 5 feet of drag and never fully embedded. Results for the 6K anchor were similar. Measured efficiencies were about 8 for the 3K and 6 for the 6K anchors. Based on previous experience, both anchor sizes tested performed as if the fluke angles were too large.

For this situation, penetrating resistance exceeds anchor penetrating force before the anchor flukes are fully embedded. With continued load, the anchor drags horizontally with no further embedment. A small pressure variation on the flukes can produce an unbalanced moment, which causes the anchor to rotate until the anchor stabilizer contacts the seafloor (see Figure 19). The anchor will continue to drag in that position. Discussions with civilian users of the MOORFAST anchor have indicated similar problems in hard soils. A reduction in the fluke angle from 34 degrees to about 28 degrees for a 45,000-pound MOORFAST in conjunction with a stabilizer length extension led to substantial anchoring improvement for a recent hard soil anchoring situation off Alaska. For Navy use, a reduction in fluke angle to about 28 degrees is recommended and is easily made by enlarging the wedge insert provided with each anchor. Added discussion on fluke angle requirements is provided later in the Penetrating Angle in Sand and Tripping Angle sections.

STATO Anchor. Results for the five tests conducted are plotted in Figure 20. Results for each test are very similar. Anchor efficiency was about 8, and anchoring efficiency was about 12. In each case, the anchors ceased penetrating and began to rotate after a few feet of drag. All test anchors had a 32-degree fluke angle and extended stabilizers. The test results show that this fluke angle was excessive and resulted in performance similar to that described for the MOORFAST anchor. At first, this was surprising, but after comparison with the previous results of tests at San Diego, it became apparent that a further reduction in STATO fluke angle was necessary for satisfactory performance in dense sand.

San Diego results are presented in Figure 21. Except for test 4/14, the behavior of the STATO for all the tests at San Diego is very similar to the behavior of the STATO in Port Hueneme sand. Peak anchoring resistance was in the 50- to 60-kip range. The one exception was test 4/14 where the STATO anchor had a 32-degree fluke angle, extended stabilizers, and achieved a peak anchoring resistance of 100 Kips. For the next test (5/15) the STATO had 32-degrees fluke angle, normal stabilizer and showed the same instabilities noted with the STATO with a 37-degree fluke angle and normal stabilizers. Based on this limited data, it was tentatively concluded that both the 32-degree angle and extended stabilizers were needed for good STATO performance in sand. The Port Hueneme results suggest that that conclusion was premature. It appears that for the 3,000-pound STATO the 32-degree fluke angle was very close to being suitable; in test 4/14 it was, in test 5/14 it was not, and in all Port Hueneme tests it was not.

These results, except test 4/14 at San Diego, are all in contradiction to previous results reported by Towne (Ref 9). In Towne's tests, there was no evidence of instability or inability to fully penetrate, based on the smooth and continually increasing load-drag distance curves reported. In an effort to understand why Towne's results differed from those of the present tests, his test procedures were studied. It was noted that all of Towne's tests in sand were conducted in deeper water (> 70 feet) than the present tests (30-50 feet) off the west jetty at Port Hueneme. Due to wave action, seafloor sand density should increase as water depth decreases. Further corroboration that the soil density was less for Towne's tests than for the recent tests came from the

results of chain pull tests. Towne's tests showed an average chain efficiency of 1.2 compared to 1.4 for the recent test. Sand density is directly related to the soil friction angle and therefore soil strength. As soil strength increases, the anchor fluke angle needed to enable full penetration decreases. Thus, it is concluded that the differences between Towne's and the present tests were due to seafloor soil density differences. Fluke angle recommendations for the STATO and other anchors are included in the section entitled Penetrating Angle-Sand.

BRUCE Twin-Shank Anchor. The BRUCE Twin-Shank anchor was pulled twice at Port Hueneme without the instrument package; therefore, only deck load and wire angle were recorded. Results are plotted in Figure 22 along with the previously unpublished results of a single test conducted in corally sand at Guam. At Guam the anchoring efficiency was 44, and the anchor efficiency was 31; at Port Hueneme the tests were stopped after 30 feet of drag at anchoring efficiencies of 13 to 14. The excellent performance at Guam occurred on the second try at embedment. In the more dense sand at Port Hueneme, the anchor did not penetrate. Subsequent to these tests, the manufacturer reduced the fluke angle for sand by 5 degrees to correct the penetration problem. Trials with this modification are scheduled for early 1982 in Europe.

Penetrating Angle in Sand

The penetrating angle as defined here is the external angle subtended by the anchor fluke and the seafloor and is the minimum penetration angle above which complete anchor fluke embedment will not occur (see Figure 23). Penetration angles for various conventional anchors are plotted versus anchor weight in Figure 23 for the standard fluke angle settings for the various anchors in sand.

The variation in the STATO curve (Figure 23) shows that the STATO design is not exactly geometrically similar. The practically straight line plots for the STEVFIX, STEVDIG, LWT, and Danforth show geometric similarity. Above 6,000 pounds, the actual penetrating angle for the STATO is among the largest of the available high efficiency anchors. The 1,000- to 6,000-pound sizes deviate from this and show penetrating angles which reflect a need for reduced angles as anchor weight decreases. With increasing anchor size the pressure exerted on the soil by the anchor fluke increases as $(\text{weight})^{1/3}$. Therefore, the critical penetrating angle should increase as anchor weight increases. The STATO was developed through field trials, and modifications to each anchor were made as necessary to optimize performance for the soil conditions at the test site. This empirical development method did appear to be closing on the correct solution.

When the 3,000-pound STATO was recently tested at Port Hueneme, it had a 32-degree fluke angle (61.5-degree penetrating angle); for this situation, the anchor did not fully penetrate before becoming unstable. The same anchor was marginally satisfactory at San Diego: at 62 degrees, the 1,000-pound STATO performed poorly; at 65 degrees, the 6,000-pound STATO was marginally suitable. The 200-pound STATO with a 69-degree penetrating angle was replaced by a Danforth anchor on the NCEL dive boat because the STATO did not function consistently in Port Hueneme sand conditions. Both the 3,000- and 6,000-pound MOORFAST anchors

penetrated poorly in Port Hueneme sand. The 2,200-pound STEVDIG was borderline satisfactory in San Diego sand. The STEVFIX generally performed satisfactorily in sand at San Diego but did experience some initial penetration difficulty. The lightweight anchor types (LWT and Danforth) are considered to be good sand, hard soil anchors; their low penetrating angles coupled with narrow, sharp flukes are key reasons for this behavior.

Additional guidance is provided in the literature concerning anchor behavior as a function of fluke angle. Reference 10 shows that a smooth-fluked anchor will penetrate and thus hold better than a rough-fluked anchor. In addition, the optimum fluke angle for a rough fluked anchor will be 5 to 7 degrees less than for a smooth-fluked anchor. Reference 11 shows through model studies that a ribbed fluke gave lower holding pull than a smooth fluke. Towne (ref 9) was aware of this but the requirement to use mild steel in the design necessitated ribs on the STATO for structural strength.

With this as background, it seems clear that the STATO, MOORFAST, and very likely the smaller sizes of OFFDRILL anchors should be modified to display lower penetrating angles for good sand behavior. This can be accomplished by slight fluke length reductions combined with fluke angle reductions or by fluke angle reductions alone. In addition, for the STATO, the flukes could be tapered more near the end and the full sides of the flukes beveled to improve penetration. Minor changes to the STATO anchor are needed to improve its behavior in sand. It appears that a reduction in penetration angle to about 59 degrees for sizes to 15,000 pounds should be suitable. Table 3 lists existing and modified STATO fluke lengths to achieve the above penetrating angles using a standard 29-degree fluke angle for sand. The table shows small fluke length changes with the reductions in fluke and penetrating angles. The changes could be neglected without sacrificing performance. Tests of small STATO anchors in dense submerged sand should be performed to substantiate the above recommendations on STATO modifications.

To improve MOORFAST performance, a reduction in penetrating angle to at least 62 degrees appears justified based on its performance, fluke shape, and fluke roughness. This could be accomplished by a simple reduction in fluke angle to 28 degrees or by combined changes in fluke angle and fluke length.

Tripping Angle

The tripping angle is the angle the anchor fluke makes with the seafloor as the anchor lies on the seafloor. The angle depends upon fluke length and the height of the anchor crown. For example, see the STATO anchor with attached mud palms in Figure 6B. The mud palms raise the crown end of the anchor and increases the angle (tripping angle) that the anchor flukes make with the seafloor. In the prior section on penetrating angle in sand, anchor penetration was discussed in terms of anchor penetrating angle. However, in hard soils, unless the anchor flukes bite into the seafloor and cause the anchor flukes to open or unless the flukes are partially or fully pre-opened, fluke angle reduction alone will not guarantee good anchor penetrability.

If the anchor flukes do not trip, as evidenced by anchor capacities near anchor weight and the anchor cannot be control-lowered to the seafloor in a pre-opened configuration in shallow water, the soil beneath the anchor flukes could be jetted out or, preferably, the anchor shank could be extended by a lightweight pipe or plate construction. This would increase anchor fluke tripping angle regardless of the anchor's deployed orientation.

INDIAN ISLAND TEST RESULTS

Chain

For this series of tests, measured chain efficiency (chain resistance/chain in-water weight) was reasonably consistent and averaged 0.7. This was about 25% lower than the average for the 1980 Indian Island tests (Ref 2). Load cells were recalibrated on site and in the laboratory at the conclusion of the test program and all load cell calibrations were still correct, thus the data are felt to be accurate. The difference in chain efficiency can be attributed to the amount of time the chain was in contact with the soil. This series of tests was conducted during a 2-1/2 day span compared to 9 days for the 1980 tests. Typically, the chain was left on the seafloor for substantially longer periods of time during the 1980 series of tests which probably caused consolidation and strengthening of the soil in contact with the chain. This would result in larger values of static chain friction and therefore larger chain efficiency.

Performance of Anchors

Summary data for the twelve large anchor tests at Indian Island are listed in Table 2. The listed values are self-explanatory except for some of the values of anchoring efficiency. Values of anchoring efficiency in Table 2 were computed by subtracting the resistance of the chain on the seafloor (chain weight x 0.7) from peak horizontal mooring load and dividing the result by anchor weight. In several instances, the anchoring efficiency computed was less than the anchor efficiency; for these cases, the larger value of anchor efficiency was listed. This apparent discrepancy can be explained if the chain sliding efficiency is less than the measured static efficiency of 0.7; this was not directly measured but would be typical for any seafloor soil. For a chain efficiency less than 0.7 the computed chain resistance would decrease; thus, the load attributed to the anchor and buried chain would increase, resulting in a larger calculated anchoring efficiency. Use of static chain efficiency in the calculation of anchoring efficiency is admittedly slightly conservative. All reduced data for the Indian Island tests are provided in Appendix C.

Two-Fluke Balanced Anchor. Results for the four Balanced anchor tests plot similarly in Figure 24. The presence of the ball guide apparently had little effect on the performance of the anchor. Anchor efficiency varied from 2.5 to 2.9. The anchors were stable with drag but penetrated poorly into the seafloor – about 3 to 4 feet penetration measured to the end of the shank. Compared to the behavior of the basic

Stockless anchor, this could indicate that the anchor flukes did not trip. Forerunners of the Balanced anchor (AC-17), the AC-11, -12, and -14 experienced burial difficulties in very soft mud seafloors (Ref 12). Plotted for comparison on Figure 24 are the results of 1980 Stockless anchor tests at Indian Island (Ref 2). The 9,000-pound Stockless anchor is similar in size to the 8,000-pound Balanced anchor. The differences in behavior were notable particularly for the Stockless anchor with fixed fluke. It held 50% more than the Balanced anchor. Even the stabilized Stockless anchor with movable flukes held 18% to 20% more than the Balanced anchor. Load at the anchor for an unstabilized 9,000-pound Stockless anchor with movable flukes was unavailable, but based on total mooring load comparisons, the basic Stockless anchor in mud was about 15% less efficient than the stabilized Stockless anchor. A 15% load reduction in the lower Stockless curve would result in a curve similar to that for the Balanced anchor. The conclusion drawn previously for the Stockless anchor was that the anchor flukes opened partially or not at all during drag. It appears that the same conclusion could be drawn for the Balanced anchor for soft mud, particularly in light of the very shallow burial.

The Balanced anchor appears equal to the Stockless anchor in mud in performance. Its primary advantages for submarines appear to be its stowability and consistent behavior in the more competent seafloors (sands, clays).

MOORFAST Anchor. Two tests of the 6,000-pound MOORFAST anchor were conducted. The consistency of the results suggests that this was suitable to evaluate behavior. Anchor load versus drag distance for the tests are plotted in Figure 25. For comparison purposes, results of 1980 tests (Ref 2) of the 3,000-pound STATO anchor are plotted. The MOORFAST anchor resembles a cast version of the STATO; however, for equal weights, the STATO anchor has substantially more fluke area. The 3,000-pound STATO has about 10% more fluke area than the 6,000-pound MOORFAST anchor. If the curves of Figure 25 were normalized by anchor fluke area, they would be quite similar. For like anchors, it appears that performance is directly related to anchor fluke area. The similarity in the MOORFAST and STATO curves also shows that the MOORFAST anchor did trip and penetrate into the seafloor. Peak measured anchor efficiency based on the nominal 6,000-pound anchor weight was 5 (5.5, based on actual weight of 5,400 pounds). This translates to about 30,000 pounds of peak capacity for the 6,000-pound MOORFAST compared to a projected 41,000-pound capacity for the 3,000-pound STATO (based on nominal weight, anchor efficiency = 13.7). This capacity difference is higher than can be simply explained by fluke area differences alone. The performance advantage for approximately sized (not weighted) MOORFAST and STATO anchors can be explained by the differences in anchor bearing areas. The thicknesses of the major parts of the cast MOORFAST (e.g., fluke, shank) are larger than those for the fabricated STATO, thus the higher bearing area and reduced penetrability. The projected capacity of the STATO was determined by first extrapolating the normalized *embedment curve for the STATO (see Figure 26) to peak embedment depth of 3.1 x fluke length, or about 18-1/2 feet to the fluke

*Normalized by anchor fluke length.

tip. Then, the capacity at that depth is calculated according to the accepted equation for predicting the capacity of embedded plates in cohesive seafloors (Ref 13):

$$H_A = N_c(A\ S_u) \quad (1)$$

where H_A = anchor capacity

N_c = anchor holding capacity factor

A = anchor fluke area

S_u = average undrained soil shear strength

The value of N_c determined from the 1980 STATO tests (Ref 2) using known soil strength, capacity, and anchor depth and orientation data was approximately 13.

According to the data, its apparent that the STATO has a performance advantage over the MOORFAST for fleet mooring applications where the anchors are deployed under controlled conditions and rough handling is not the norm. However, in temporary Navy moorings, where rough handling is possible, the structural advantages of the MOORFAST are obvious. This is the primary reason why this anchor type has enjoyed wide use in the offshore industry where rough handling is often encountered.

BRUCE Twin-Shank Anchor. Results for the two 500-kg BRUCE Twin-Shank anchor tests were reasonbly consistent and are plotted in Figure 27. Peak measured anchor efficiencies of 10 to 11 are slightly less than the 12.4 recorded in 1980 for a 340 kg BRUCE-Twin Shank and three to four times that recorded for the cast BRUCE anchor in mud at Indian Island (Ref 1). Anchor capacity was normalized by anchor fluke area in Figure 28 for the two sizes of BRUCE anchor. These results show the constancy of behavior for the geometrically scaled BRUCE-Twin-Shank anchor in mud. Geometrically scaled anchors are sized such that anchor dimensions are proportional to $(\text{weight})^{1/3}$. This shows that the anchor embedment trajectories are similar for the two anchors even though the same chain size was used for 500- and 340-kg anchor tests. Both of the anchor sizes were tested with 2-inch chain and the maximum anchor capacity is certainly affected by the type and size of the ground tackle. The test chain mooring line was certainly oversized based on the actual measured capacities of the BRUCE Twin-Shank anchor; however, the lines were sized according to larger anticipated capacities. The anchor efficiencies determined from the three BRUCE tests should be conservative. With wire or smaller-sized chain, the anchor would continue to embed until the anchor burial and chain uplift forces came into equilibrium. A more thorough understanding of this process is underway with the development of a mathematical model describing anchor behavior as a function of soil engineering properties.

PRISMA Anchor. The PRISMA anchor with cutter was tested twice without the instrument package on the anchor due to time constraints. Total anchoring load, line angle, and barge displacement were the only data recorded. Anchoring efficiencies for the two tests listed in Table 2 were 6.4 and 7.4 and were calculated using a chain efficiency of 0.7 and total weight of 1,895 pounds for anchor and cutter. As mentioned previously, sliding chain efficiency is probably less than 0.7 and more

likely closer to 0.5 which would result in a 20% increase in calculated anchoring efficiency. A 33% additional increase would result if the weight of the cutter was not included in the calculation. In mud, it is doubtful that the cutter had a significant influence on anchor penetrability. As with the BRUCE-Twin-Shank, 2-inch chain was used which turned out to be much larger than required; however, chain was sized according to much larger anticicpated loads. This probably has a somewhat negative effect on anchor performance, but in comparison to tests of a similar anchor, the HOOK, the data show that the PRISMA was not behaving as expected. For example, a 1,250-pound HOOK anchor with 2-inch chain and with substantially less fluke area than the PRISMA was tested in 1980 at Indian Island (Ref 1); it penetrated about 20 feet, and exhibited anchoring efficiencies of more than 20.

The two tests of the PRISMA by NCEL were the first tests conducted on this new anchor. Before any real conclusions can be drawn regarding the general effectiveness of the PRISMA, additional trials would be needed. Although anchors appear simply configured, their behavior is very sensitive to slight changes in configuration, and it would be impractical to believe that an effective anchor design could be developed without experimentation and modification.

STEVFIX Anchor. Results for the two tests of the 11,000-pound STEVFIX anchor are plotted in Figure 29. The STEVFIX with movable flukes (test 11) failed to trip in the soft Indian Island mud. The tripping behavior was not unexpected. The same tripping problems occurred during the previous Indian Island tests with a 1,408-pound STEVFIX (Ref 1). With the flukes in the standard movable fluke condition, the anchor dragged along the seafloor surface. With the flukes blocked open, the anchor rapidly penetrated the seafloor. This tripping problem is not typically encountered in offshore commercial practice because the anchors are deployed such that the anchor fluke is down and the anchor is being pulled horizontally as it encounters the seafloor. This type of deployment is not practical for most Navy applications; therefore, it would be necessary to partially pre-open the flukes prior to deployment.

The load-displacement curve for test 12 of Figure 29 is annotated with seafloor chain angles. There was not sufficient chain to maintain a zero chain angle at the seafloor surface. The data seem to indicate that the anchor behavior, at least up to 80 feet of drag (8-degree chain angle), was not affected by the non-zero angle. Previous results (Ref 9) have shown 5% to 38% reductions in total anchoring efficiency in mud when chain pull direction changed from horizontal to 12 degrees above horizontal. It is probable that a large percentage of the recorded reductions was due to reductions in the resistance provided by the buried chain rather than reductions in the capacity of the anchor. Figure 30 normalizes anchor load by anchor area for the 11,000-pound STEVFIX and the 1,408-pound STEVFIX. Again, the similarity of behavior for geometrically-scaled anchors is evident. The slopes of the curves for the two anchors during embedment are similar, indicating similar embedment trajectories. Chain angle remained at 0 degrees for the 1,408-pound anchor and exceeded 0 degrees beyond 55 feet of drag for the 11,000-pound anchor; yet, the slope of the curve did not change until chain angle exceeded about 8 degrees. The change beyond this point could have been partly due to anchor rotation which had reached 33 degrees at 95 feet of drag.

The normalized *embedment of the STEVFIX anchor was plotted with the STATO data on Figure 26. The STEVFIX embeds at less than half the rate of the STATO and penetrates deeper. Projected embedment for the STEVFIX is 3.5 to 3.75 x fluke length (L) compared to 3.1L for the STATO. Maximum drag distance for the STEVFIX is projected to be 28L compared to 8L for the STATO. This is significant for Navy fleet moorings, where anchor setting distance must be short to avoid slack moorings.

Another interesting difference between these anchors is their capacity as a function of soil strength. As shown previously for the STATO, the nondimensional anchor holding capacity factor (N_c) for the STATO anchor was 13; the value of N_c calculated from all Indian Island tests of the STEVFIX anchor is about 6.5 (HOOK anchor is similar). This lower value of N_c is characteristic of the deeper burial type conventional anchors. The deeper burial anchor embeds with the anchor fluke at a shallow angle (8 to 10 degrees) to the embedment trajectory angle. The STATO anchor flukes exhibit a substantially greater angle (20 to 25 degrees) to the trajectory angle and therefore projects a much larger area to the direction of travel. Resulting holding capacity per unit area for the STATO is twice that of the STEVFIX for the same soil shear strength. STEVFIX anchor fluke area is 70% greater than the STATO and the anchor embeds 12% to 20% deeper; thus, projected capacities of similarly weighted anchors in a normally consolidated soil are approximately equal. Projected peak anchor efficiency of the 11,000-pound STEVFIX would occur at a fluke tip embedment of 32.7 feet (3.5 x 9.33-foot fluke length) in the mud at Indian Island and would equal 14 compared to 13.7 for the STATO. Total anchoring efficiencies would exceed these values, however, the procedure for properly accounting for the mooring line contribution has not yet been finalized. Initial indications are that buried chain can contribute 20% to 50% (larger increase for smaller anchors) of total anchoring resistance. Use of anchor-alone efficiency for design would be conservative.

WISHBONE Anchor. Only two tests each of the 25- and 60-pound WISHBONE anchors were conducted because of time limitations. The 60-pound anchor behaved consistently, holding 550 pounds on test 1 and 480 pounds on test 2. The 25-pound anchor held 125 pounds on test 1 and 25 pounds on test 2, indicating that the anchor fluke did not trip for the second test. The surficial soil at Indian Island is weak, and for this situation it would not be uncommon to pull a small boat anchor several times before tripping and holding.

SUMMARY AND CONCLUSIONS

This report provides the test results of conventional temporary and permanent mooring anchors in dense fine sand at Port Hueneme, CA, and normally consolidated silty clay at Indian Island, WA. These tests provide data that can be used to quantify anchor capacity, to guide anchor selection, to improve the understanding of anchor behavior, and to guide the formulation of empirically and theoretically founded schemes to define anchoring capacity. Although the number of tests performed on each anchor during the recent anchor tests in sand and mud was limited,

*Normalized by fluke length.

the repeatability of the data was excellent, and correlations with previous NCEL tests (Ref 1 through 4) provided added insight into the specific behavior of the tested anchors and into the general behavior of anchor and chain. Inferences and conclusions concerning specific and general anchor behavior follow.

Chain

1. Based on data from San Diego, Port Hueneme and Guam, that part of total anchoring resistance provided by the chain embedded in a sand seafloor by the downward reaction of the anchor shank is directly related to anchor load and independent of chain size and sand properties. The embedded chain held about 20% of the total anchoring load. Further evaluation of this simple relationship is justified; however, it certainly leads towards the development of a simplified empirical predictive scheme for defining anchoring capacity in sand seafloors.

2. The efficiency of surface dragged chain for Port Hueneme sand averaged 1.4 (based on in-water weight) with a high of 1.88 and a low of 1.27. It is clear that there is no unique value for chain efficiency for Port Hueneme and other sands.

3. Static chain efficiency in Indian Island mud was reasonably consistent and averaged 0.7 compared to 0.9 for previous Indian Island tests.

Two-Fluke Balanced Anchor

1. In sand, the Balanced anchor was stable with drag, developed holding capacity rapidly (peak capacity in 30 to 40 feet) and achieved approximately the same ultimate capacity with and without ball guide. Based on nominal weight of 8,000 pounds, anchoring efficiency in sand of 8 is recommended.

2. In soft mud, maximum anchor and anchoring efficiency varied between 2.5 and 2.9 for the Balanced anchor without ball guide. The ball guide did not have a noticeable effect on performance. The anchor was stable with drag; however, the data indicate that the anchor flukes did not trip and penetrate which was similar to the behavior of the standard unstablized Stockless anchor in mud. From a performance standpoint, the Balanced anchor is about equal to the Stockless anchor in mud.

3. The primary advantages of the Balanced anchor for submarines is its stowability and consistent behavior in the more competent seafloors (sands, clays).

4. Where in-hull stowage is not a requirement, the ball guide contributes to weight and anchoring efficiency penalties and should not be used.

MOORFAST Anchor

1. In sand, the MOORFAST anchor achieved anchoring efficiencies of 6 and 8 for the 6,000- and 3,000-pound sizes, respectively. The low efficiencies are attributed to partial penetration caused by excessive fluke angle. To correct this problem, a fluke angle reduction to about 28 degrees is recommended for competent soils, which is done by simply enlarging the wedge insert provided with each anchor.

2. In mud, based on nominal weight of 6,000 pounds, MOORFAST anchoring efficiency was 5.2. The anchor was stable with drag, and the anchor flukes did trip and embed in the soft mud, developing peak capacity in about 50 feet of drag.

3. The MOORFAST anchor resembles a cast STATO anchor but for equal anchor weights, the STATO is somewhat more than twice as efficient. It is apparent that the STATO has a performance advantage for fleet mooring applications where anchors are deployed under controlled conditions. However, in Navy moorings where rough handling is possible, the MOORFAST anchor is structurally superior and would be recommended.

STATO Anchor

1. In Port Hueneme sand the 3,000-pound STATO with 32-degree fluke angle and extended stabilizers achieved anchoring efficiences of about 12. This efficiency is less than half that achieved with the same STATO in sand at San Diego and is attributed to partial penetration in the dense fine sand. To correct the problem, a fluke angle reduction to 9 degrees is recommended.

2. It is also recommended that the fluke angle modification be evaluated with the 200-pound STATO in dense sand.

BRUCE Twin-Shank Anchor

1. In Port Hueneme sand, the 500-kg BRUCE Twin-Shank anchor achieved an anchoring efficiency of about 14 compared to 44 in coral sand at Guam. The light anchor was unable to penetrate the dense Port Hueneme sand. Fluke angle has been reduced 5 degrees by the manufacturer to enhance embedment. This reduction should be sufficient to enable anchor penetration in the more dense sand seafloors.

2. Recorded anchor efficiency for the 500-kg BRUCE Twin-Shank anchor with 2-inch chain in mud was about 11. The welded BRUCE Twin-Shank anchor is 3 to 4 times more effective in soft mud than its predecessor, the cast BRUCE anchor.

PRISMA Anchor with Cutter

Recorded anchoring efficiency for the PRISMA anchor with cutter and 2-inch chain was about 7; neglecting the weight of the cutter, efficiency was about 9. Only two tests of this new anchor were performed in mud. Before any conclusions can be drawn regarding its effectiveness, additional data are needed.

STEVFIX Anchor

1. The STEVFIX anchor flukes failed to trip in the soft mud at Indian Island. Tripping palms are undersized, and the anchor flukes needed to be pre-opened to enable embedment. For fleet mooring applications, the anchor should be placed horizontally on the seafloor with the flukes down and fixed open.

2. Projected maximum anchor efficiency for the STEVFIX anchor in mud is 14 and is approximately constant for sizes to at least 5000-kg. Total anchoring efficiency, including chain resistance, would exceed 14, but the percentage diminishes with anchor size and could be conservatively ignored until a method being developed by NCEL to account for chain resistance is completed.

WISHBONE Anchor

Because of time limitations, only two tests each of the 25- and 60-pound WISHBONE anchors were done. One of the four anchors failed to trip, but this is not uncommon for small anchors in soft mud. Peak capacities were about 500 and 125 pounds for the 60- and 20-pound, sizes respectively.

Anchor Penetration and Tripping

1. Anchor penetrability can be defined more accurately in terms of anchor penetrating angle rather than anchor fluke angle. Penetrating angle is the external angle between anchor fluke and seafloor. Anchors with similar fluke angles can have vastly different penetrating angles.

2. The MOORFAST and STATO anchors exhibit the highest penetrating angles of any high efficiency anchors. Reductions in their fluke angles to 28 and 29 degrees, respectively, from the standard 34-degree fluke angle are recommended for the MOORFAST and STATO, to promote penetration in hard soils.

3. Reduction in fluke angle -- and therefore penetrating angle -- can be an expedient field fix for anchors that trip but do not fully embed in competent seafloor soils.

4. Expedient field fixes for anchors that do not trip in hard seafloors are to place the anchor with flukes pre-opened, to extend the crown which increases tripping angle, or in shallow water to jet beneath the anchor flukes to open and fully embed the flukes without dragging.

Anchor Behavior in Mud

1. For the Indian Island tests, for similar anchors (e.g., MOORFAST, STATO), behavior (embedment trajectory and capacity) was directly related to fluke area.

2. Embedment trajectory and anchor efficiency for an anchor type that is a geometrically scaled design appear to be consistent, at least for the normally consolidated silty clay at Indian Island.

3. Empirical projections of anchor holding capacity as a function of anchor drag distance can be developed for the anchors tested during this program. This effort is on-going.

4. Embedment trajectory can be a more significant selection criteria than maximum anchor capacity in selecting an anchor size or anchor type for a Navy fleet mooring. Drag distances and embedment depth to peak

load can vary significantly between anchor types. Excessive drag distances can cause slack moorings unless installation methods are devised that allow anchor pre-setting prior to total mooring hookup.

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Table 1 Data Summary for Port Hueneme Tests

Test No.	Anchor	Anchor Weight (lb)	Anchor Load (lb)	Anchor Efficiency[a]	Peak Mooring Load (lb)	Anchoring Efficiency[b]	Anchor Drag Distance[c] (ft)	Chain Weight on Seafloor (lb)	Remarks
1	8K Two-Fluke Balanced • 40-deg fluke angle • w/ball guide	9,800	54,000	5.5	no data	--	36	--	Anchor was stable with drag.
2	8K Two-Fluke Balanced • 40-deg fluke angle • w/ball guide	9,800	48,000	4.9	80,000	6.4	38	12,161	Anchor was stable with drag.
3	3K MOORFAST • 34-deg fluke angle	3,200	18,000	5.6	45,700	7 8	12	14,887	Anchor rolled before reaching full embedment indicating an excessive fluke angle for the sand seafloor.
4	3K MOORFAST • 34-deg fluke angle	3,200	19,300	6	50,300	9.4	8	14,478	Anchor rolled before reaching full embedment.
5	6K MOORFAST • 34-deg fluke angle	5,400	no data	--	49,600	5.7	12	13,573	Anchor rolled before reaching full embedment
6	6K MOORFAST • 34-deg fluke angle	5,400	no data	--	56,700	7.0	8	13,844	Anchor rolled before reaching full embedment.
7	3K STATO • 32-deg fluke angle • extended standard stabilizers	3,500	29,200	8.3	72,200	15.3	7	13,185	Anchor rolled before reaching full embedment.

continued

Table 1 Continued

Test No.	Anchor	Anchor Weight (lb)	Anchor Load (lb)	Anchor Efficiency[a]	Peak Mooring Load (lb)	Anchoring Efficiency[b]	Anchor Drag Distance[c] (ft)	Chain Weight on Seafloor (lb)	Remarks
8	3K STATO • 32-deg fluke angle • extended standard stabilizers	3,500	30,700	8.8	60,400	11.9	16	13,493	Anchor rolled before reaching full embedment.
9	3K STATO • 32-deg fluke angle • extended pipe stabilizers	3,500	27,000	7.7	59,000	11.5	10	13,366	Anchor rolled before reaching full embedment.
10	3K STATO • 32-deg fluke angle • extended pipe stabilizers	3,500	30,800	8.8	60,100	11.9	18	13,136	Anchor rolled before reaching full embedment.
11	3K STATO • 32-deg fluke angle • extended pipe stabilizers	3,500	27,600	7.9	61,300	12.3	8	13,039	Anchor rolled before reaching full embedment.
12	500-kg BRUCE Twin-Shank • Set for sand	1,100	no data	--	35,100	12.9	6	14,865	
13	500-kg BRUCE Twin-Shank • Set for sand	1,100	no data	--	37,400	14.5	22	15,288	
14	8K Two-fluke Balanced • 40-deg fluke angle	8,000	40,000+	5+	85,200	8.5	18	11,801	Anchor was stable with drag; anchor capacity was still increasing.
15	8K Two-Fluke Balanced • 40-deg fluke angle	8,000	40,000+	5+	86,400	8.7	18	11,517	Anchor was stable with drag; anchor capacity was still increasing.

[a] Anchor alone
[b] Uses chain efficiency = 1.4
[c] Recorded at peak load

Table 2. Data Summary for Indian Island Tests

Test No.	Anchor	Anchor Weight (lb)	Anchor Load (lb)	Anchor Efficiency[a]	Peak Mooring Load (lb)	Anchoring Efficiency[b]	Anchor Drag Distance[c] (ft)	Chain Weight on Seafloor (lb)	Remarks
1-81	8K Two-Fluke Balanced • 40-deg fluke angle • w/o ball guide	8,000	23,200	2.9	--	--	60	6,392	Anchor was stable with drag.
2-81	8K Two-Fluke Balanced • 40-deg fluke angle • w/o ball guide	8,000	20,900	2.6	24,800	2.6	47	6,940	Anchor was stable with drag.
3-81	6K MOORFAST • 50-deg fluke angle	5,400	28,700	5.3	34,100	5.8	40	3,721	Anchor was stable with drag.
4-81	6K MOORFAST • 50-deg fluke angle	5,400	29,500	5.5	33,900	5.8	45	3,541	Anchor was stable with drag.
5-81	8K Two-Fluke Balanced • 40-deg fluke angle • w/ball guide	9,800	20,100	2.5[d]	24,000	2.5	43	6,541	Anchor was stable with drag.
8-81	8K Two-Fluke Balanced • 40-deg fluke angle • w/ball guide	9,800	21,800	2.7[d]	24,800	2.7	42	6,167	Anchor was stable with drag.
7-81	500-kg BRUCE Twin-Shank • set for mud	1,100	11,300	10.3	17,100	10.3	47	9,089	Anchor was stable with drag.
8-81	500-kg BRUCE Twin-Shank • set for mud	1,100	12,600	11.5	17,500	11.5	42	9,026	Anchor was stable with drag.

continued

Table 2. Continued

Test No.	Anchor	Anchor Weight (lb)	Anchor Load (lb)	Anchor Efficiency[a]	Peak Mooring Load (lb)	Anchoring Efficiency[b]	Anchor Drag Distance[c] (ft)	Chain Weight on Seafloor (lb)	Remarks
9-81	645-kg PRISMA • 50-deg fluke angle • w/216-kg cutter	1,895	--	--	18,600	6.4	42	9,259	Anchor was stable with drag.
10-81	645-kg PRISMA • 50-deg fluke angle • w/216-kg cutter	1,895	--	--	20,100	7.4	51	8,686	Anchor was stable with drag.
11-81	5,000-kg STEVFIX • 50-deg fluke angle	11,000	9,200	<1	17,500	<1	20	15,818	Anchor flukes did not trip.
12-81	5,000-kg STEVFIX • 50-deg fluke angle • blocked-open flukes	11,000	105,300+	9.6+	118,700+	10.8+	94	0	Flukes blocked open; at peak load roll was 33.5 deg; anchor capacity still increasing.

[a] Anchor alone
[b] Uses chain efficiency = 0.7
[c] Recorded at peak load
[d] Load cell was between ball guide and anchor; thus, anchor weight 8,000 lb was used to compute anchor efficiency.

Table 3. STATO Fluke Length Variations as Functions of Fluke and Penetration Angles

Weight (lb)	Fluke Angle = 34 deg		Fluke Angle = 29 deg	
	Penetration Angle (deg)	Fluke Length (in.)	Penetration Angle (deg)	Fluke Length (in.)
200	69.4	26	59	25
1,000	62.5	43	59	47
3,000	62.3	69	59	75
6,000	65.1	82	59	84
9,000	67.7	96	59	94
12,000	66.0	108	59	108
15,000	67.1	121	59	118

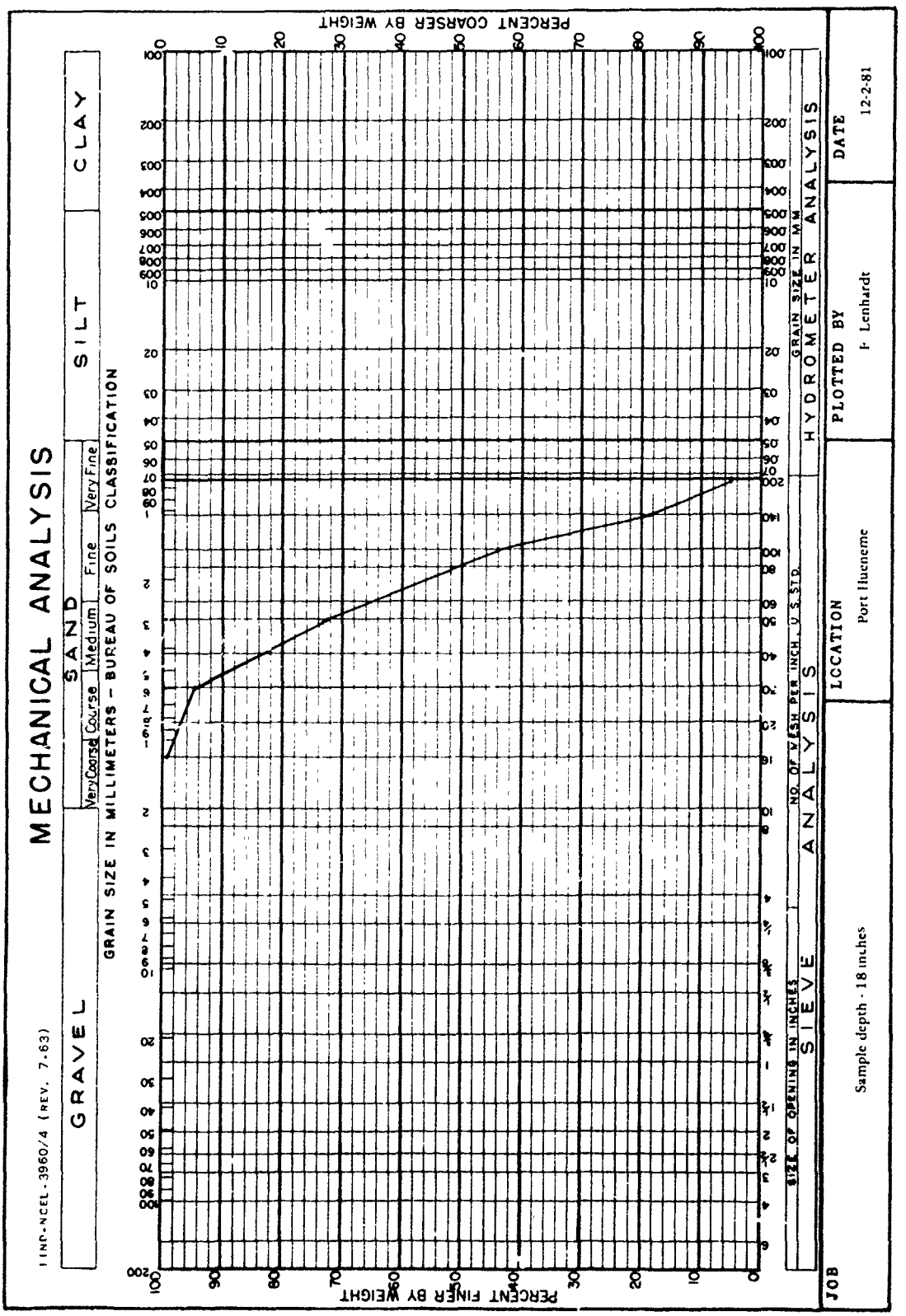


Figure 1 Grain size analysis from core sample, West Jetty, Port Hueneme sand.

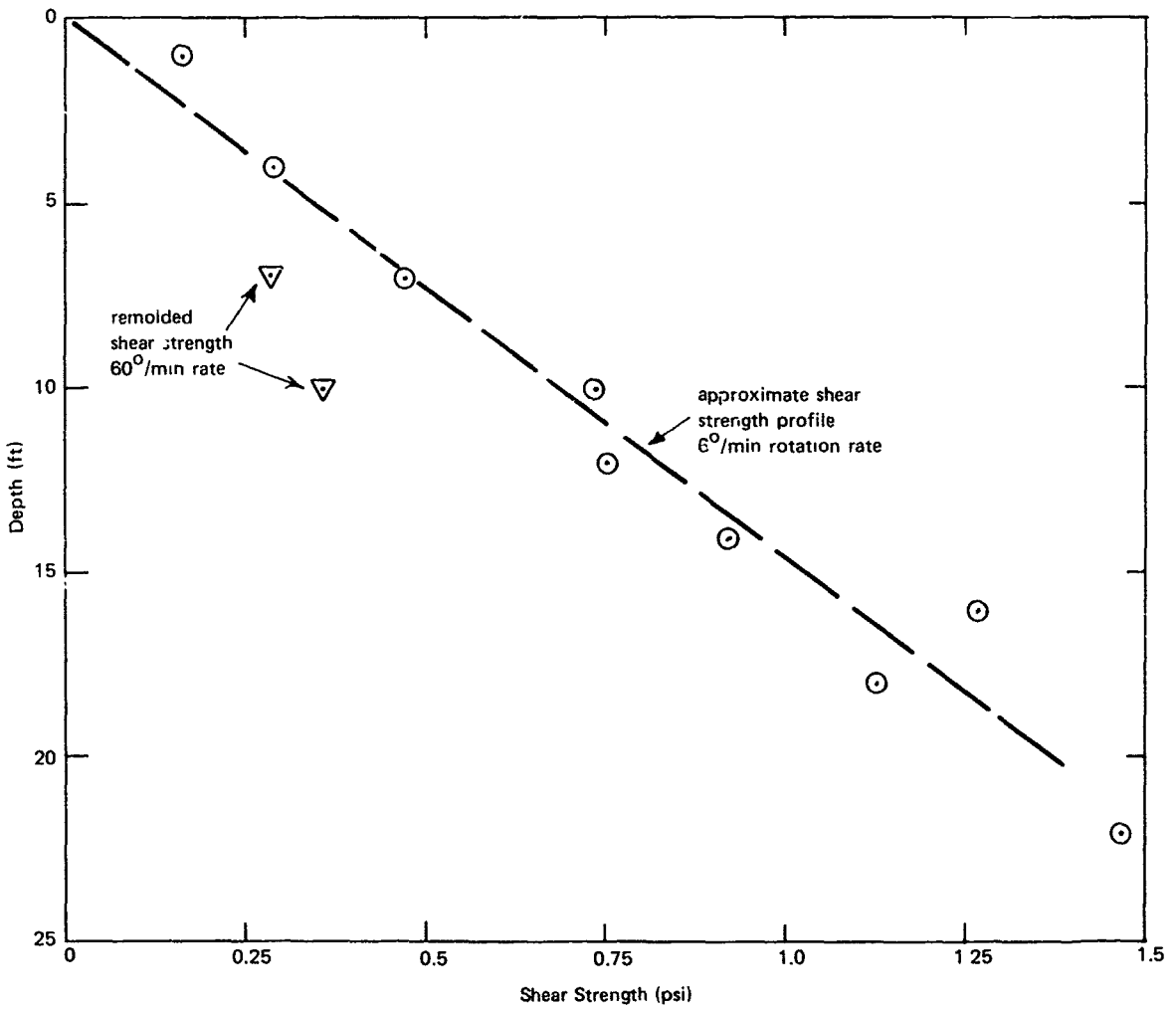


Figure 2. Vane shear strength profile for Indian Island mud.

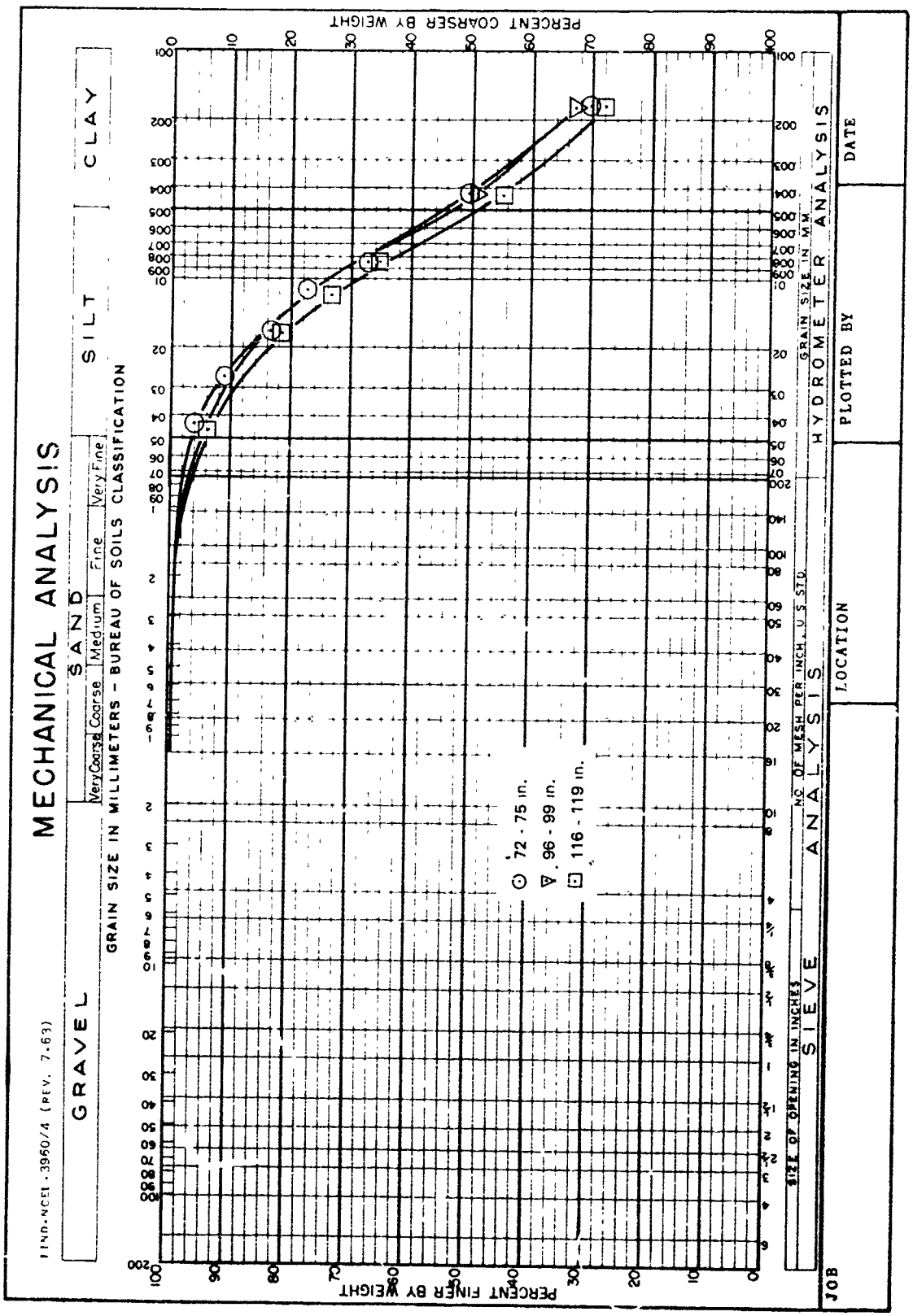
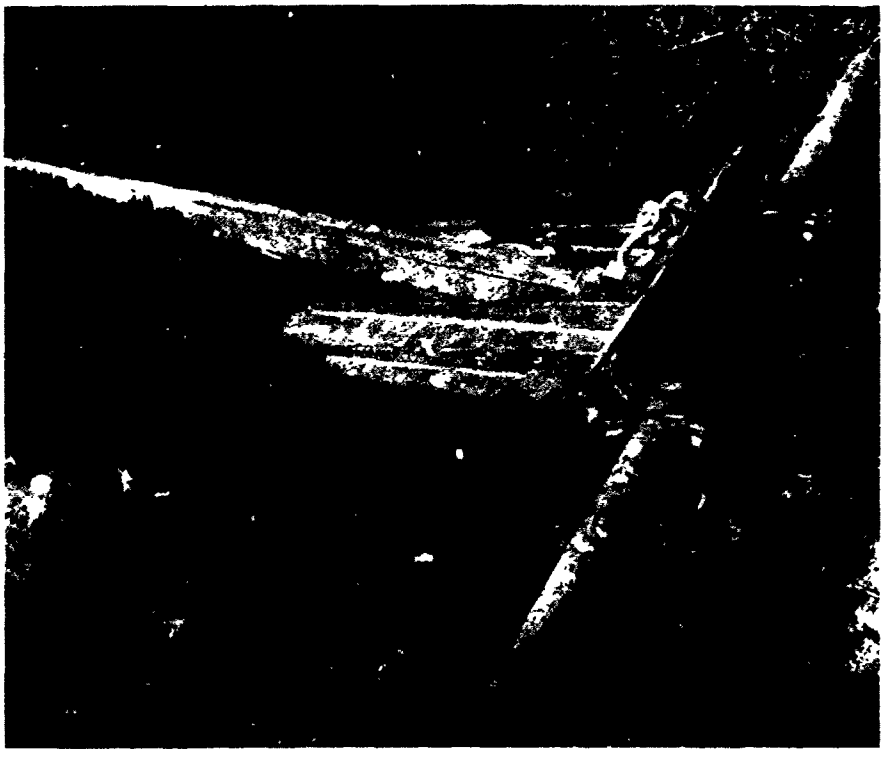


Figure 3. Grain size distribution curves for Indian Island mud.

Figure 4. Two-fluke balanced anchor with ball guide.

Figure 5. MOORFAST anchor.

(a) With standard stabilizer.



(b) With pipe stabilizer.

Figure 6. STATO anchor.

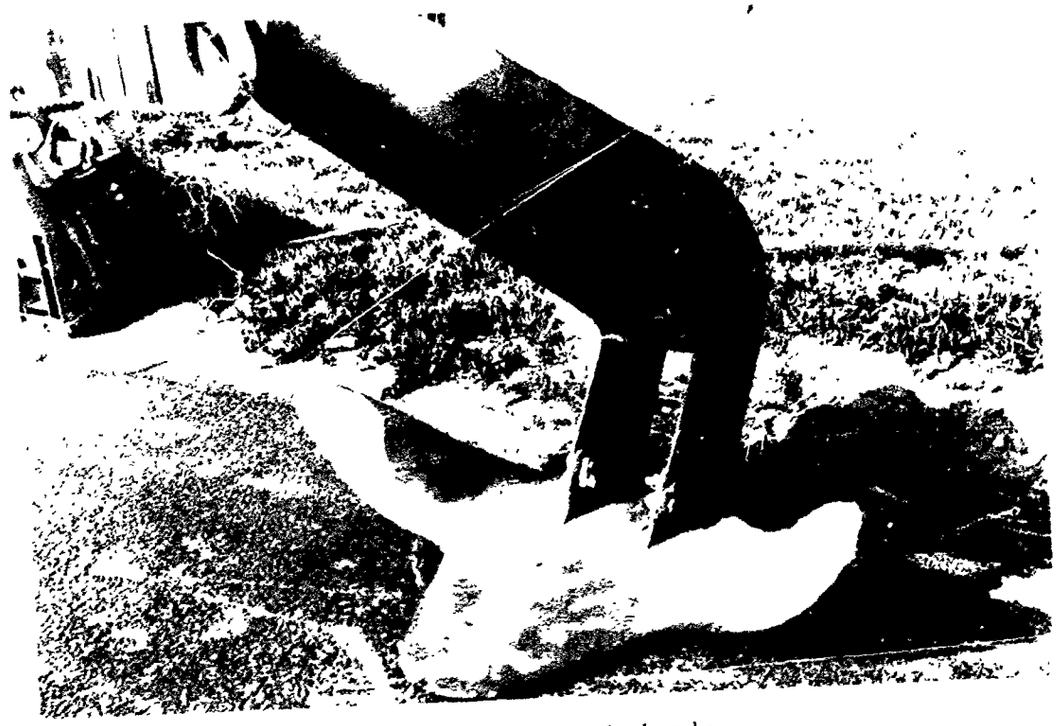


Figure 7. BRUCE twin-shank anchor.

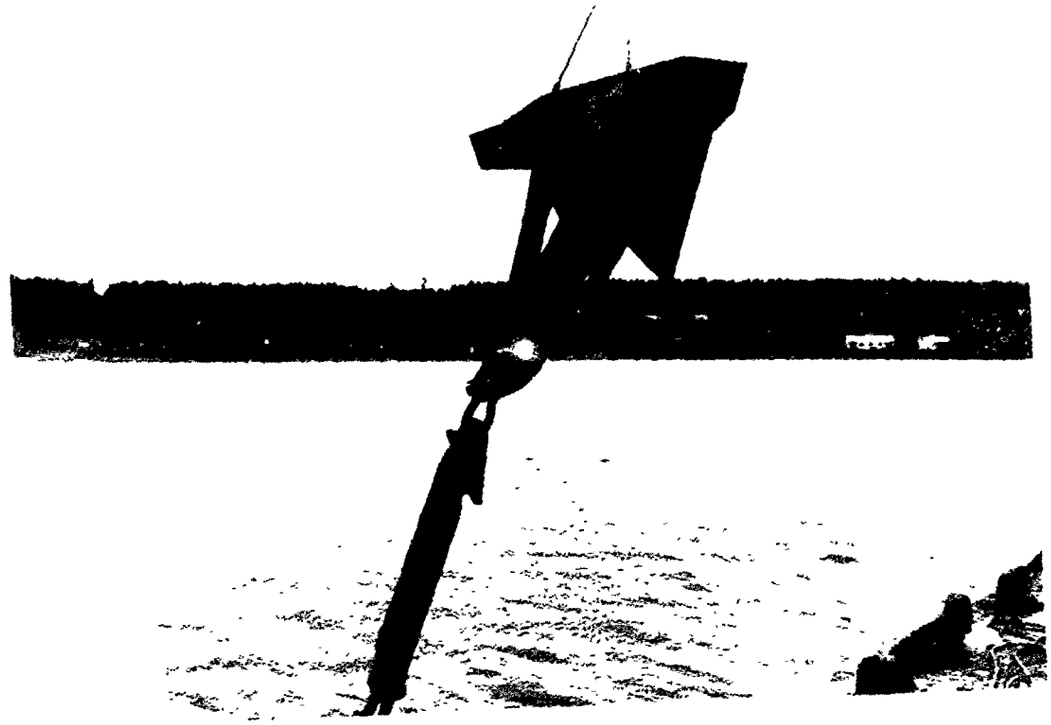


Figure 8. PRISMA anchor with cutter.

Figure 9 STEVFIX anchor.

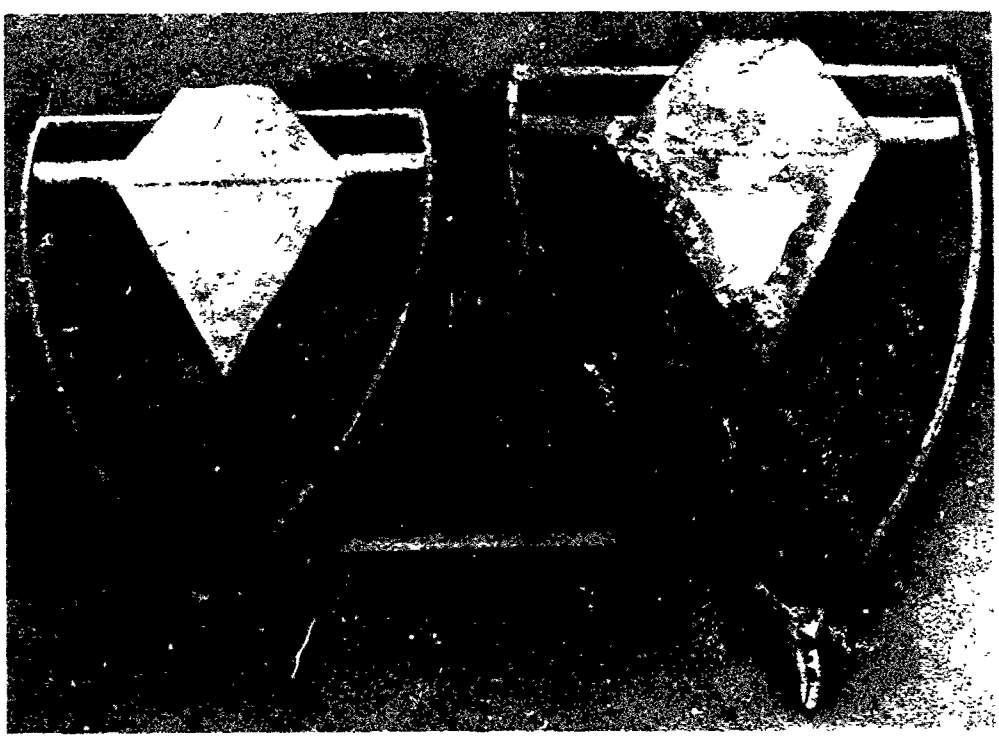


Figure 10. WISHBONE anchors (25 and 60 pounds).

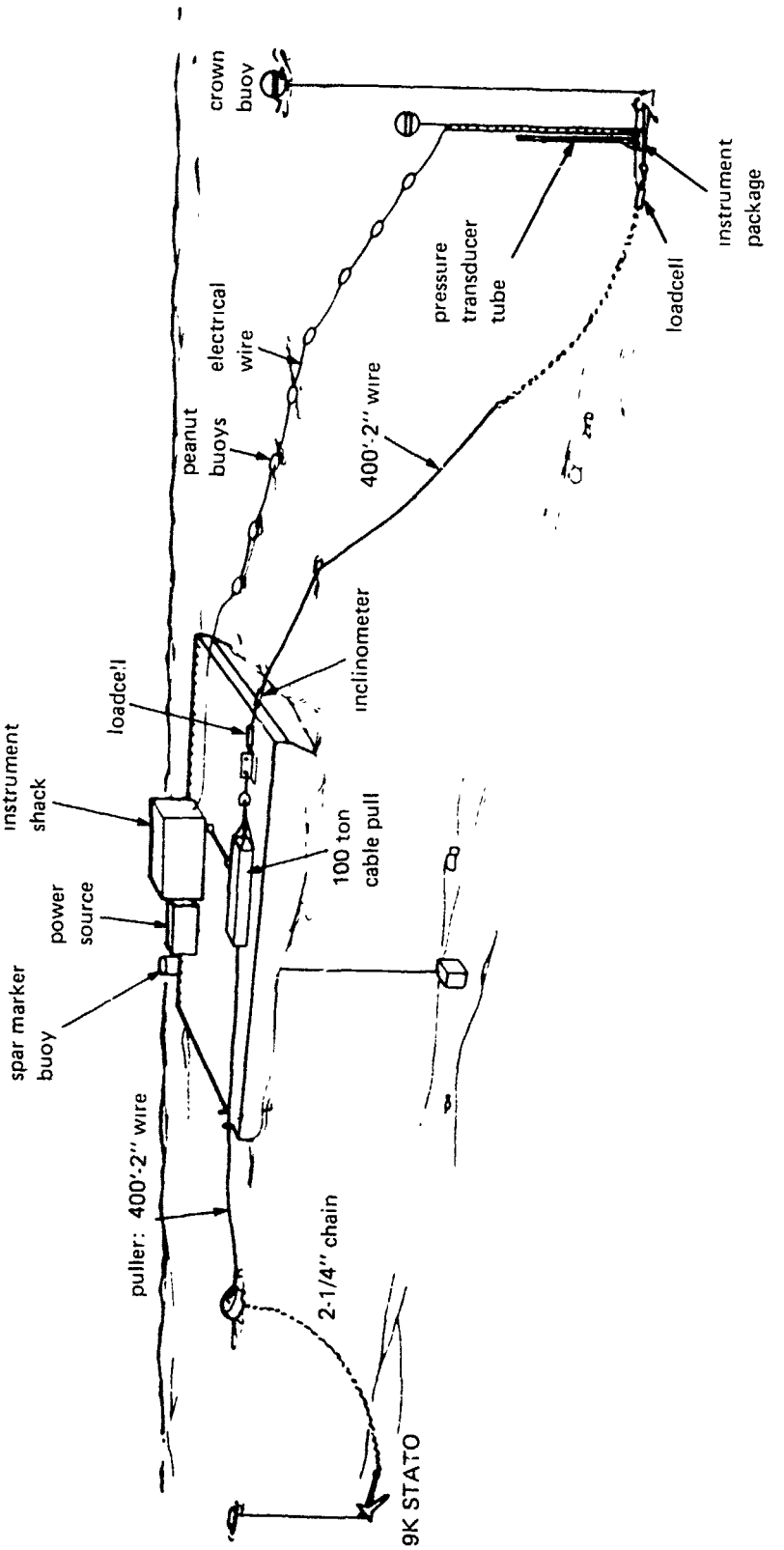


Figure 11. Anchor test setup at Port Hueneme showing major components.

Figure 12. Test anchor with anchor instrumentation system.

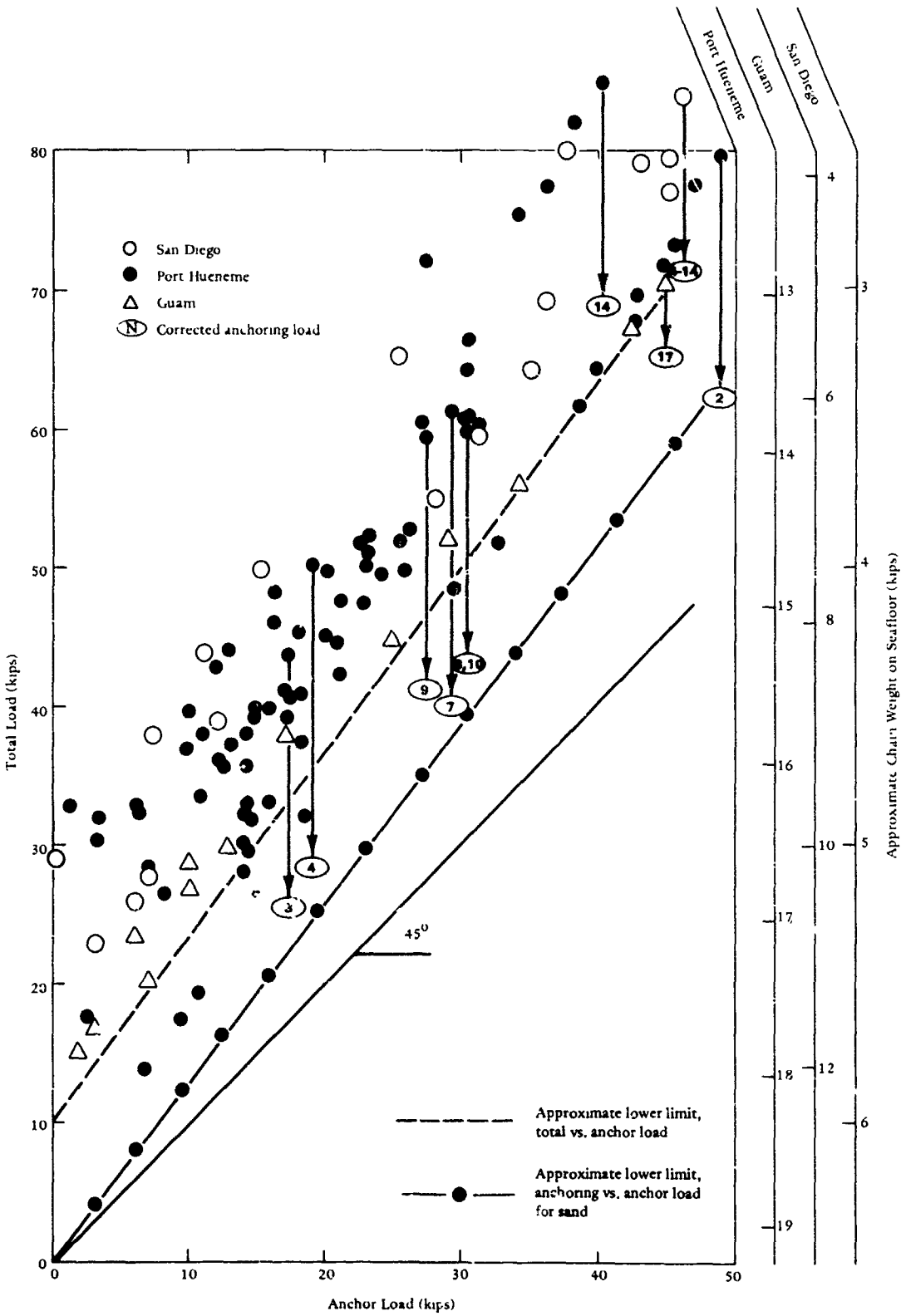


Figure 13. Total load versus anchor load for anchor tests in sand.

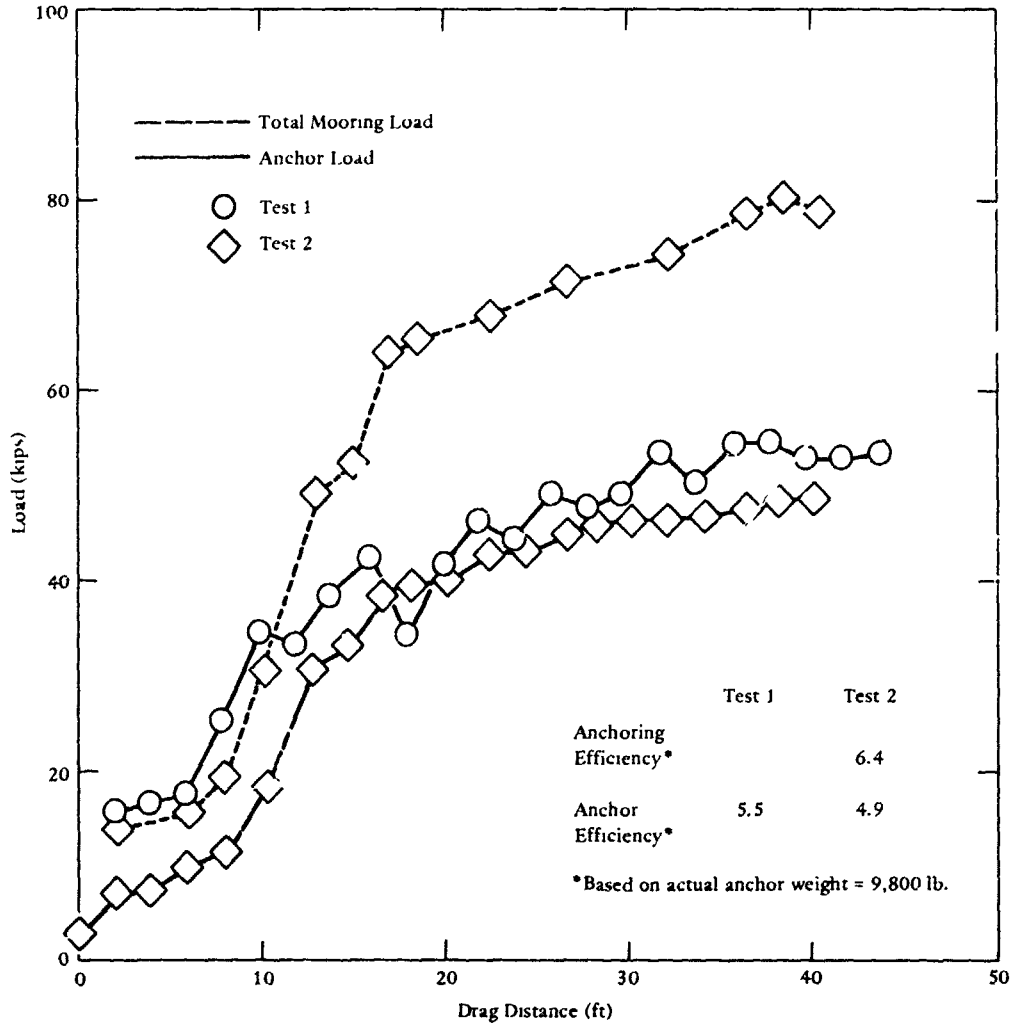


Figure 14. Load-drag distance relationships for 8,000-pound two-fluke balanced anchor with ball guide in Port Hueneme sand.

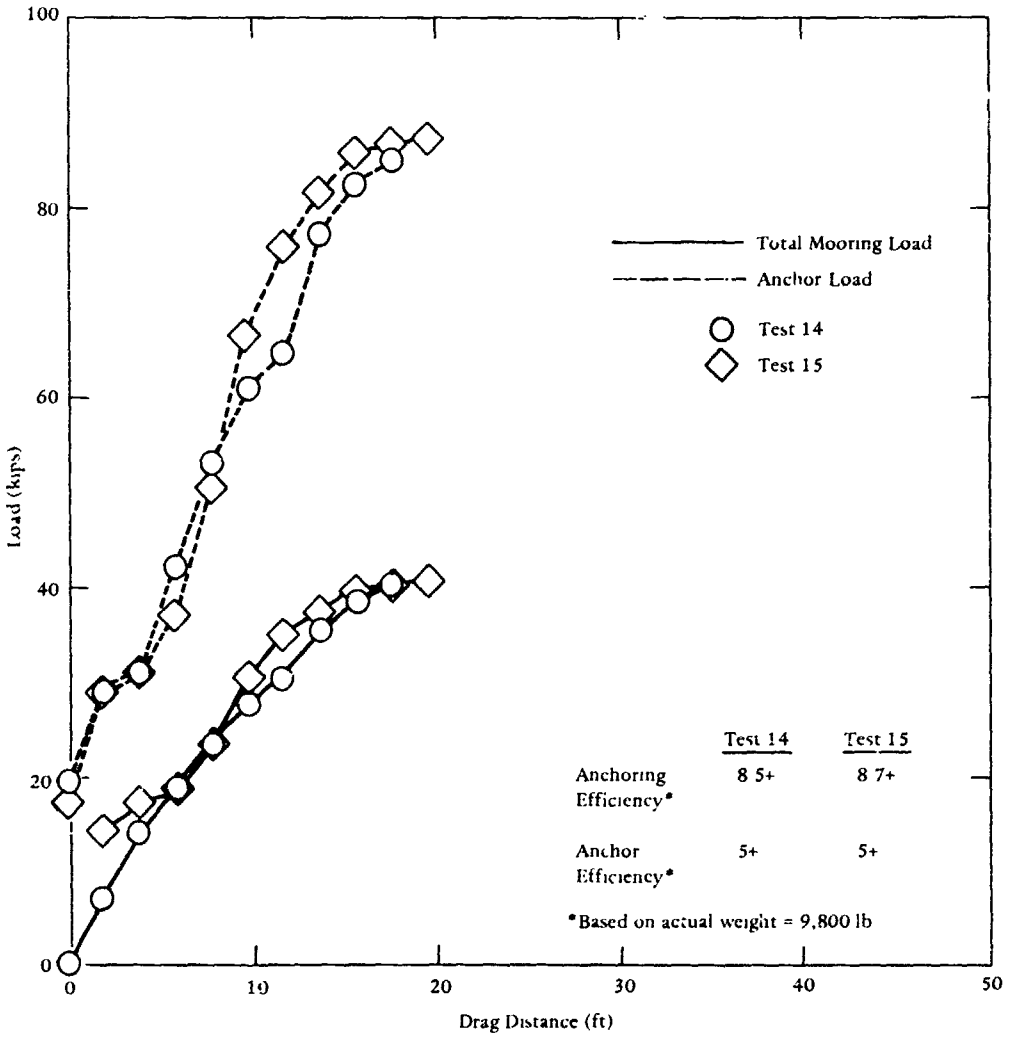


Figure 15 Load-drag distance relationships for 8,000-pound two-fluke balanced anchor without ball guide in Port Hueneme sand.

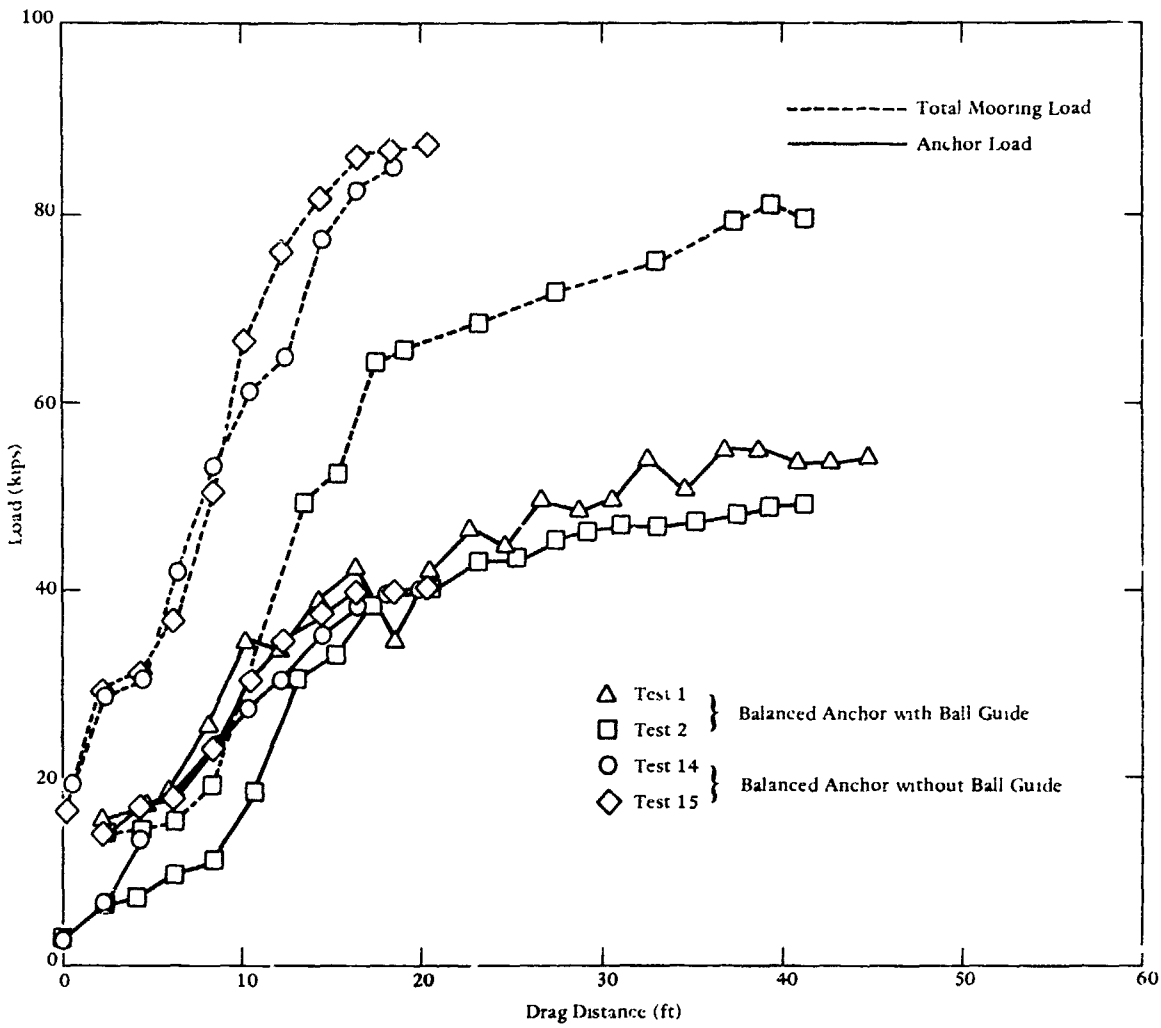


Figure 16. Load-drag distance relationships for 8,000-pound two-fluke balanced anchor in Port Hueneme sand.

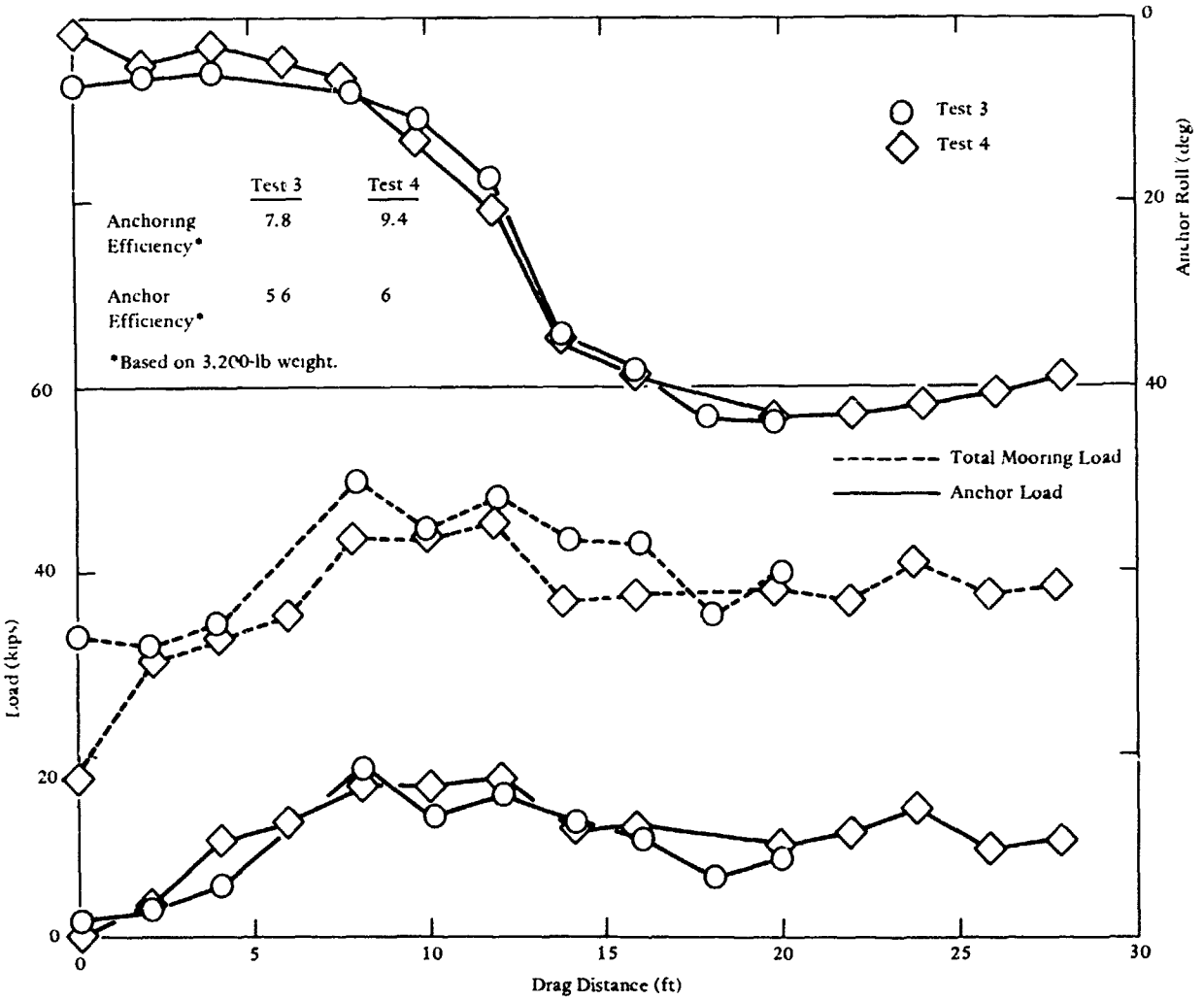


Figure 17. Test results for 3,000-pound MOORFAST anchor in Port Hueneme sand.

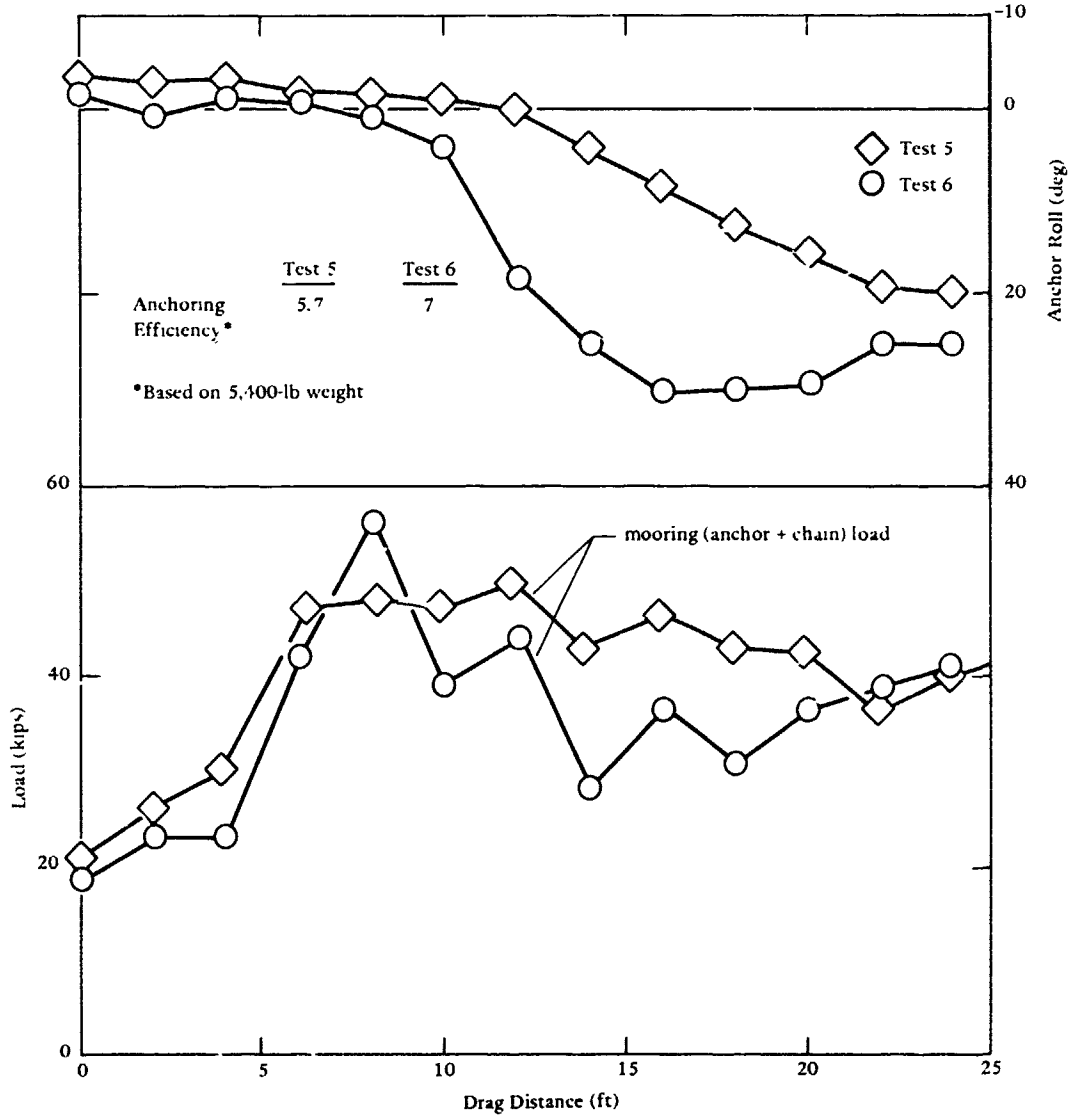


Figure 18. Test results for 6,000-pound MOORFAST anchor in Port Hueneme sand.

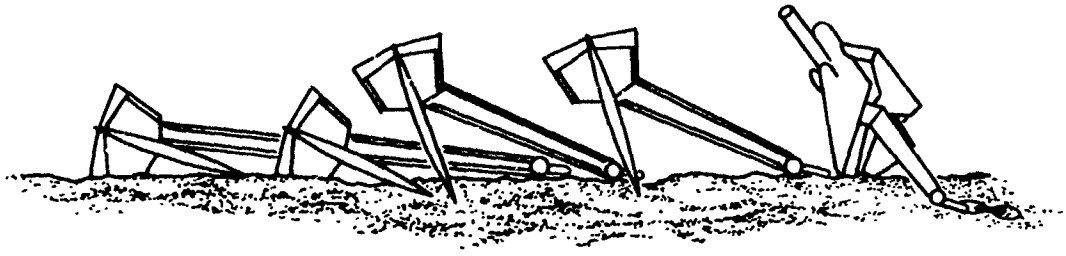


Figure 19. Anchor behavior with excessive fluke angle (after Ref 7).

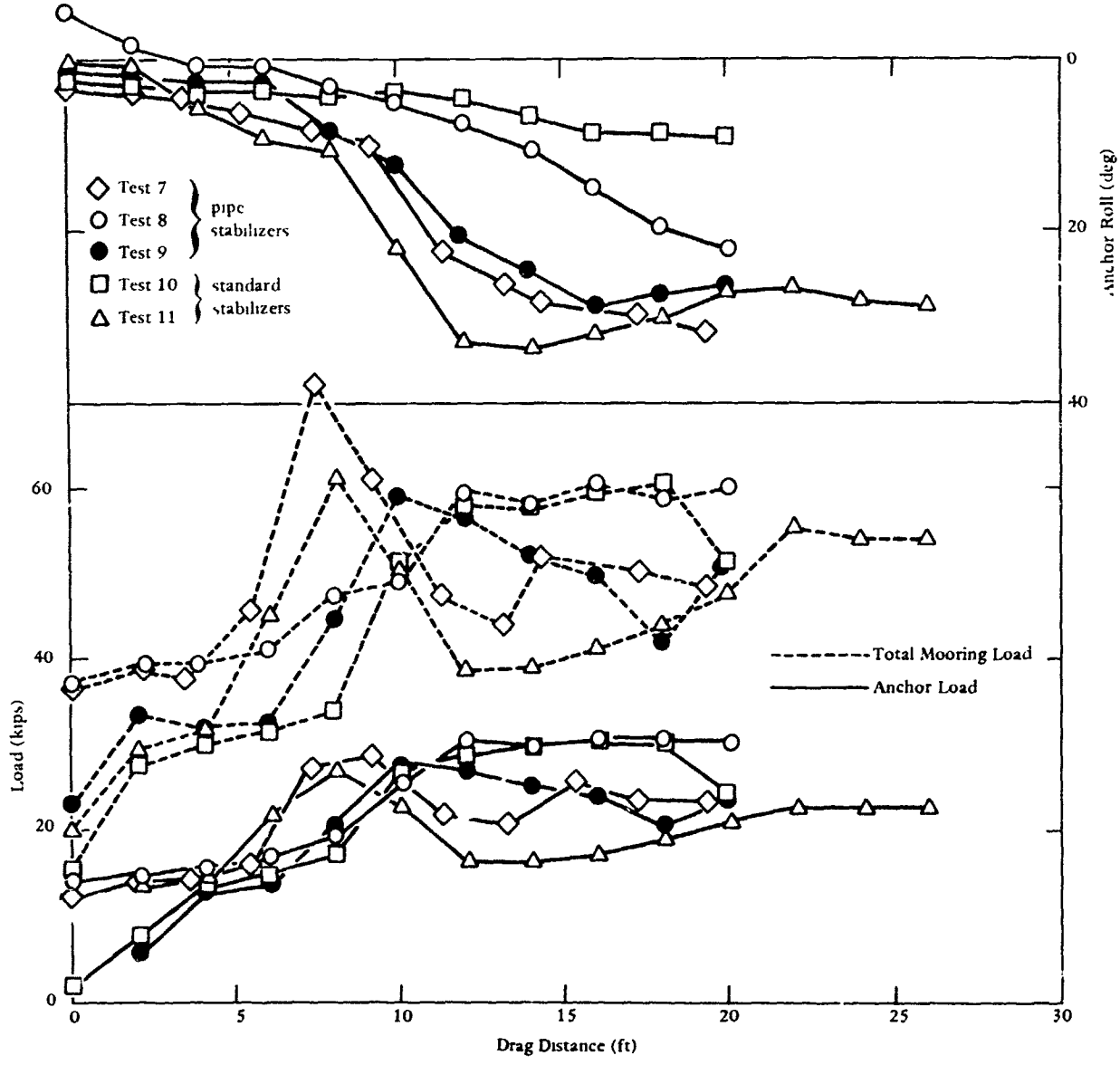


Figure 20. Test results for 3,000-pound STATO anchor in Port Hueneme sand.

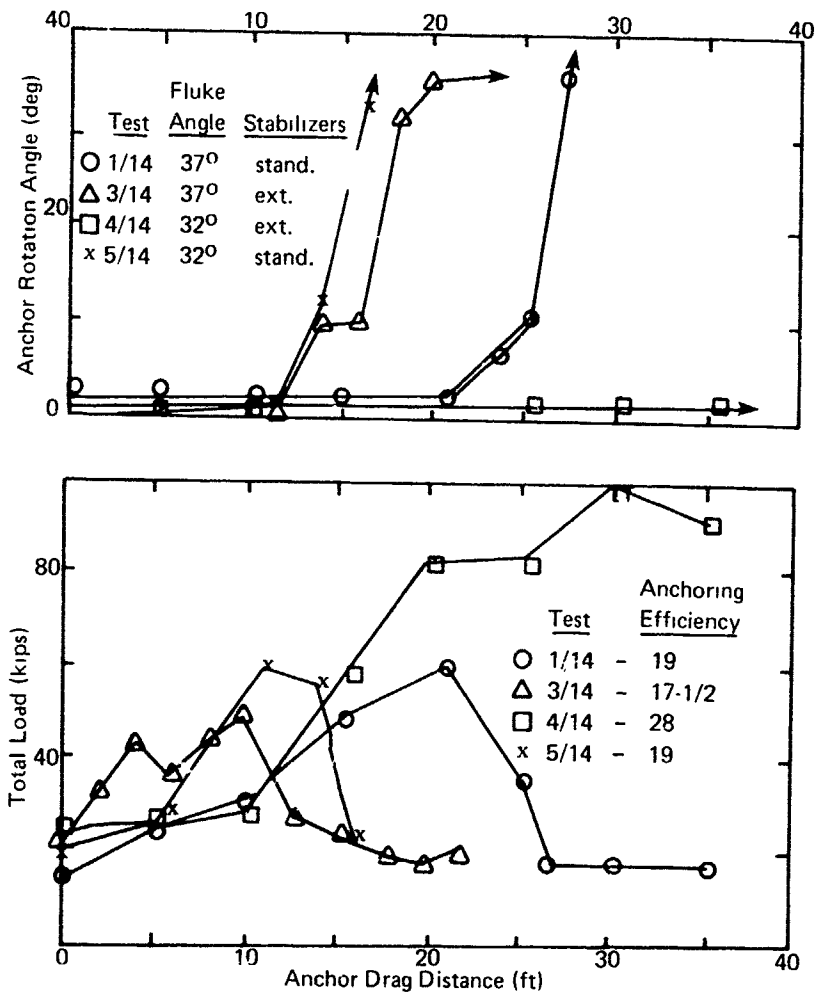


Figure 21. Test results for 3,000-pound STATO in San Diego sand (from Ref 8).

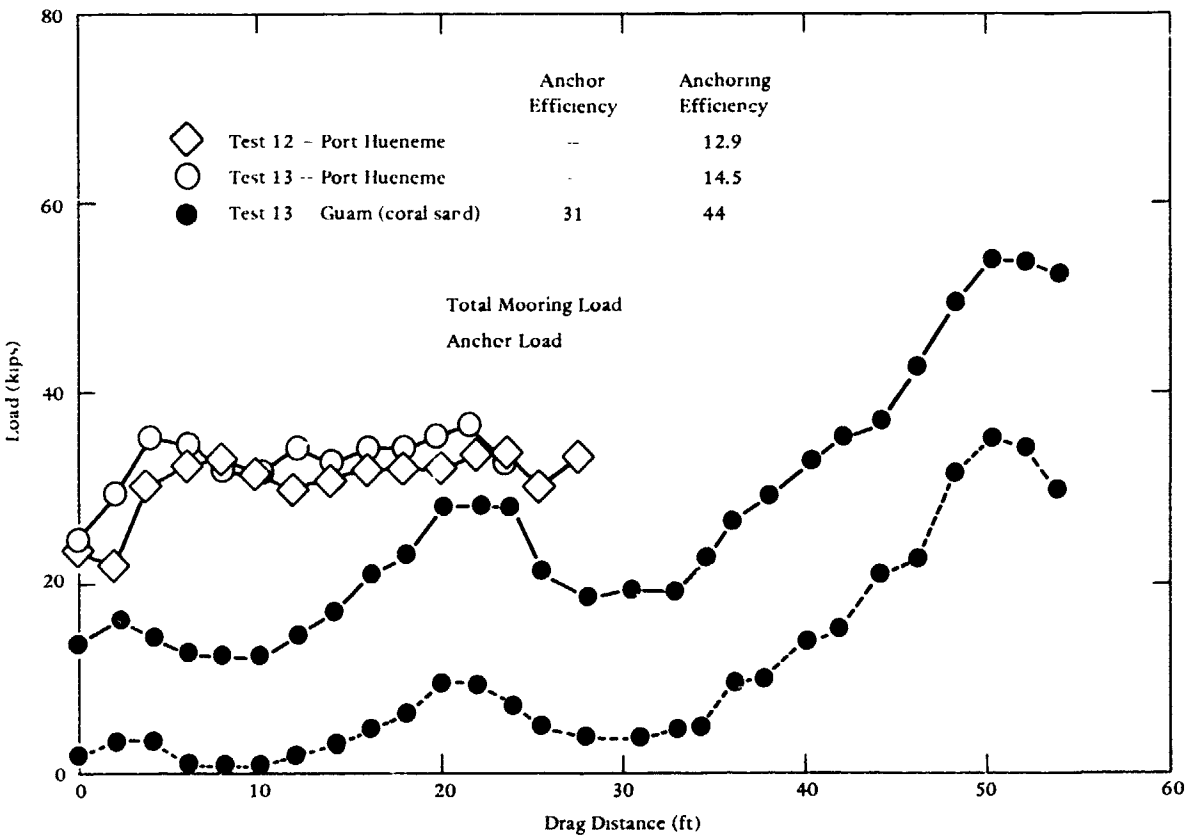


Figure 22. Test results for 500-kg BRUCE twin-shank anchor in sand.

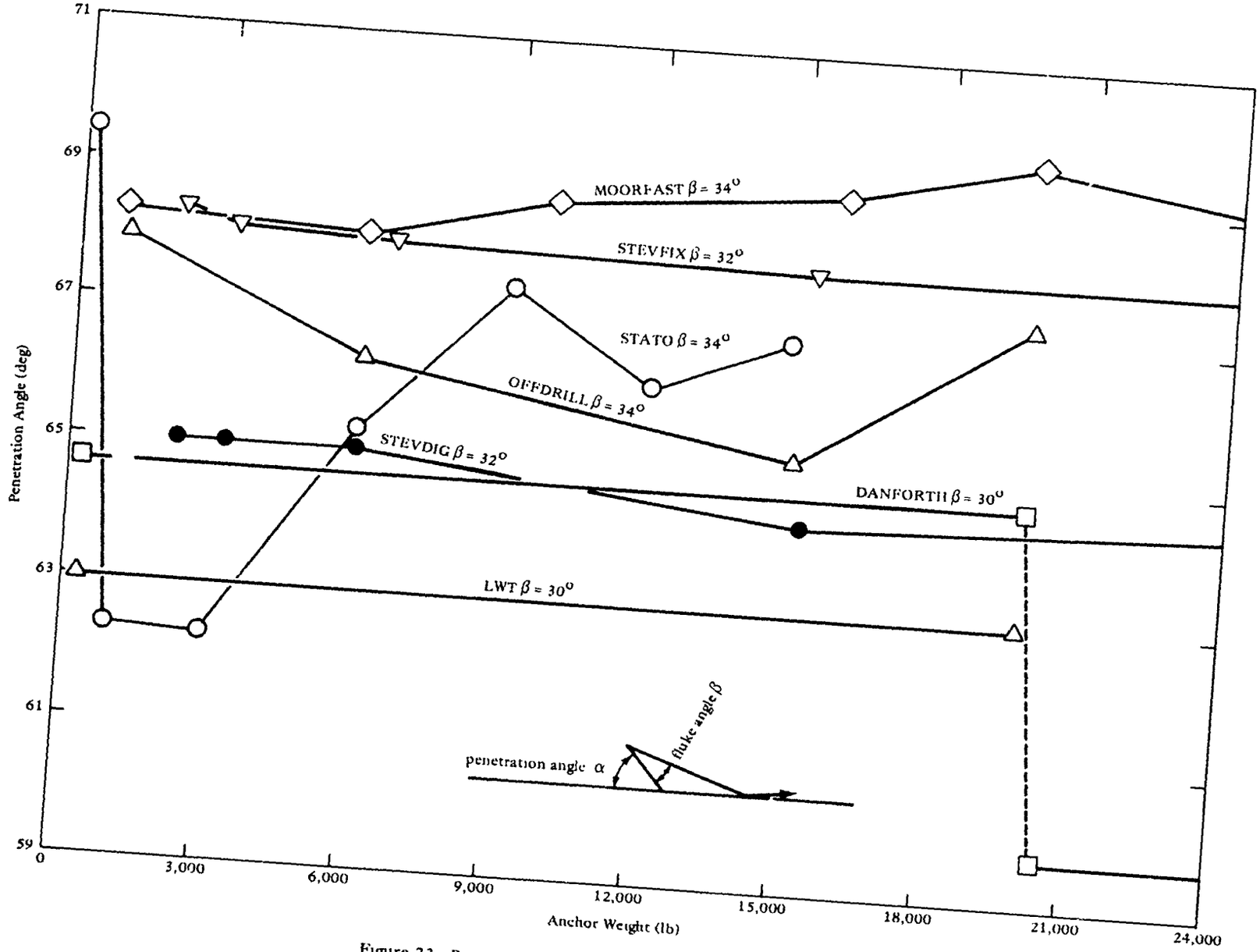


Figure 23. Penetration angle for various conventional anchors.

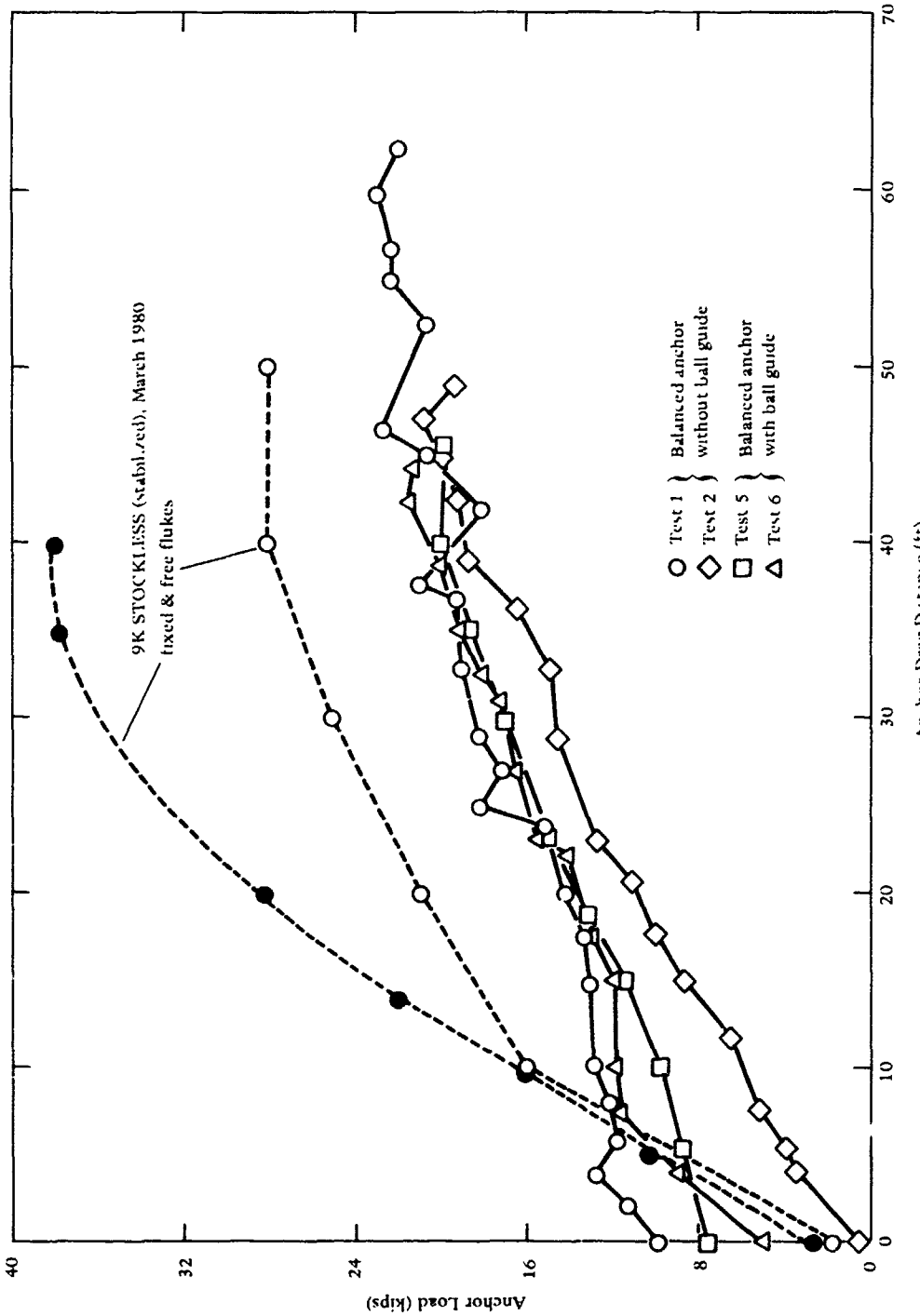


Figure 24. Anchor load versus drag distance for 8,000-pound two-fluke balanced anchor in mud.

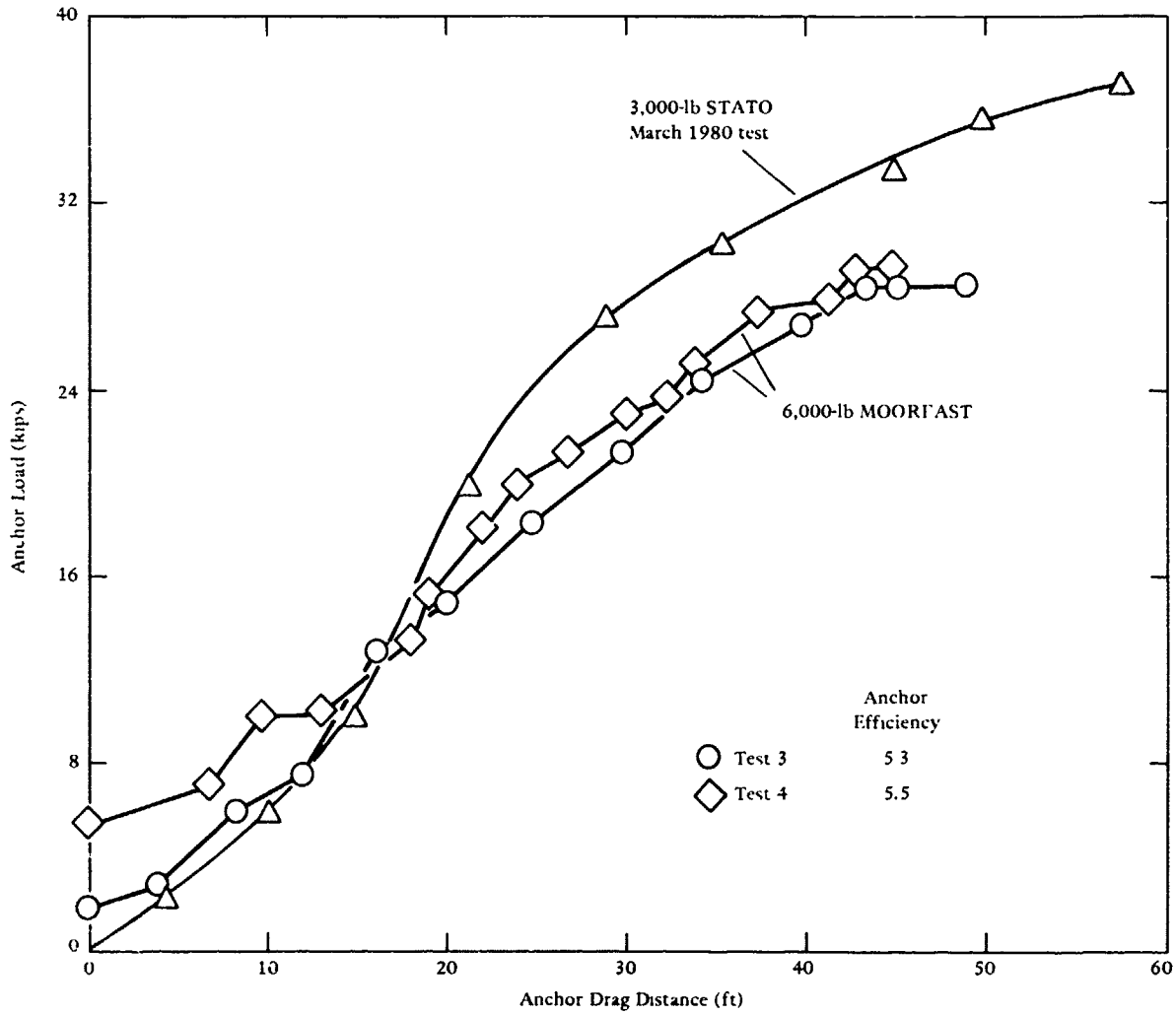


Figure 25. Anchor load versus drag distance for 6,000-pound MOORFAST anchor in mud.

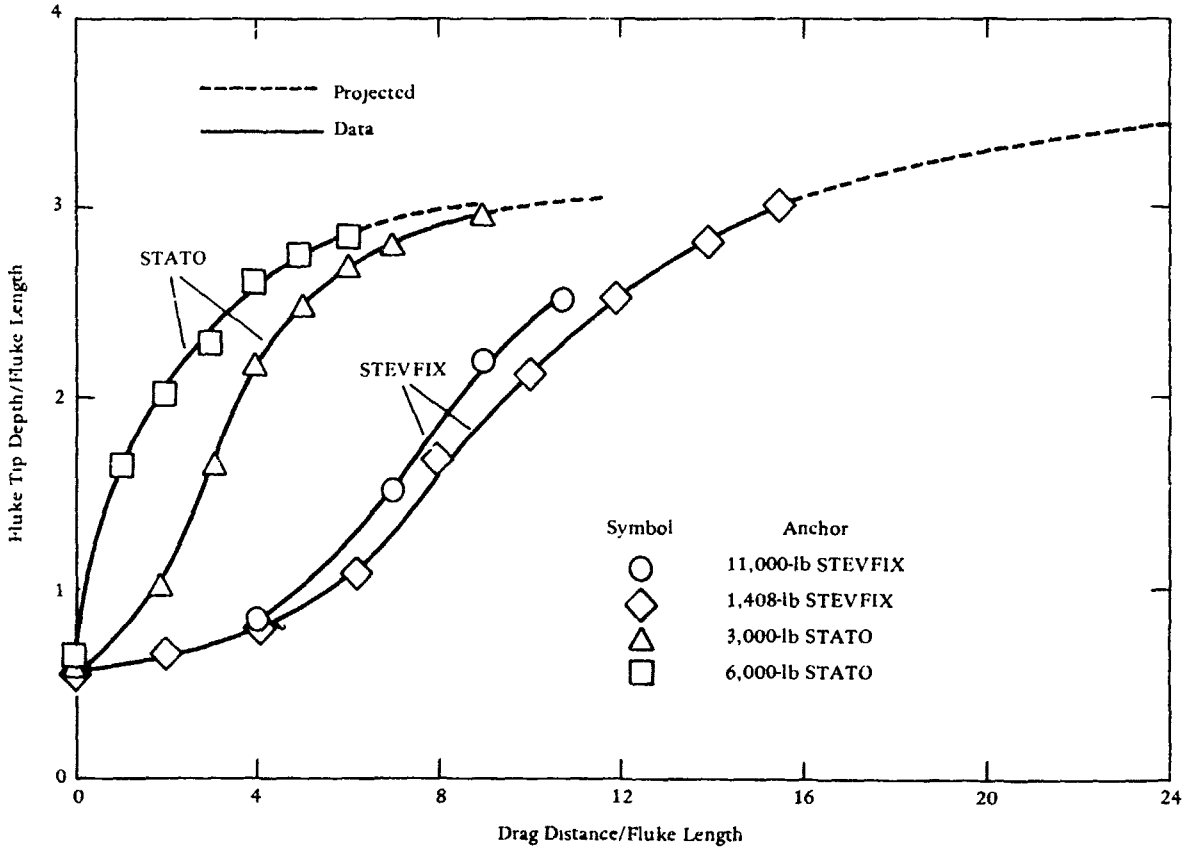


Figure 26. Normalized embedment of STEVFIX and STATO anchors in mud.

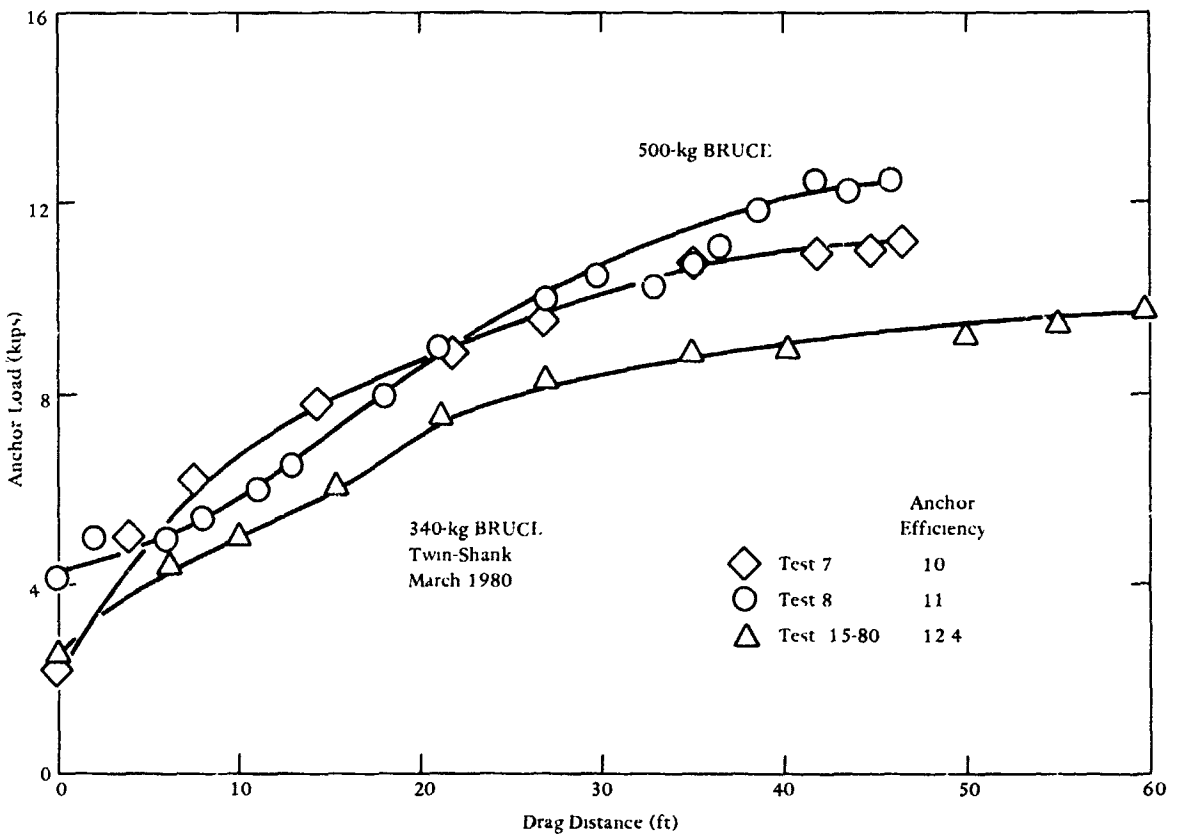


Figure 27. Anchor load versus drag distance for 500-kg twin-shank BRUCE anchor in mud.

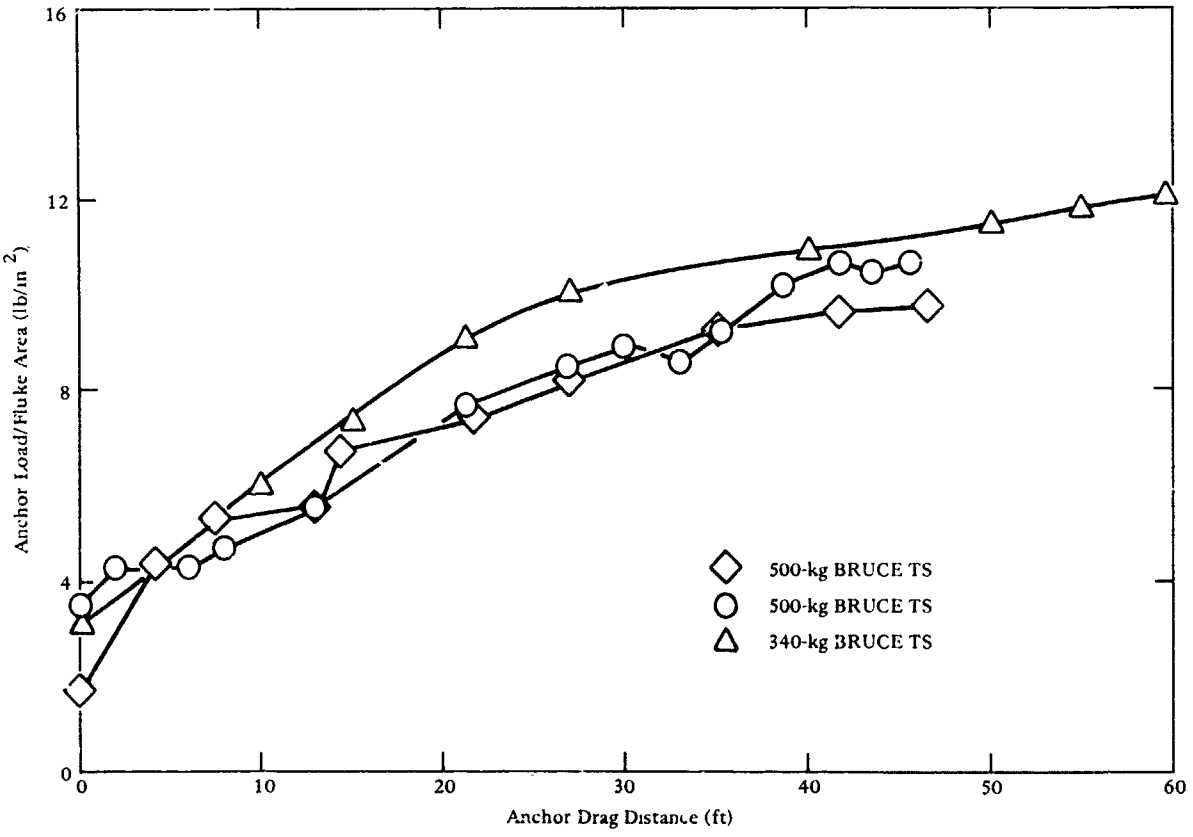


Figure 28 Anchor load normalized by fluke area versus drag distance for twin-shank BRUCE anchor in mud.

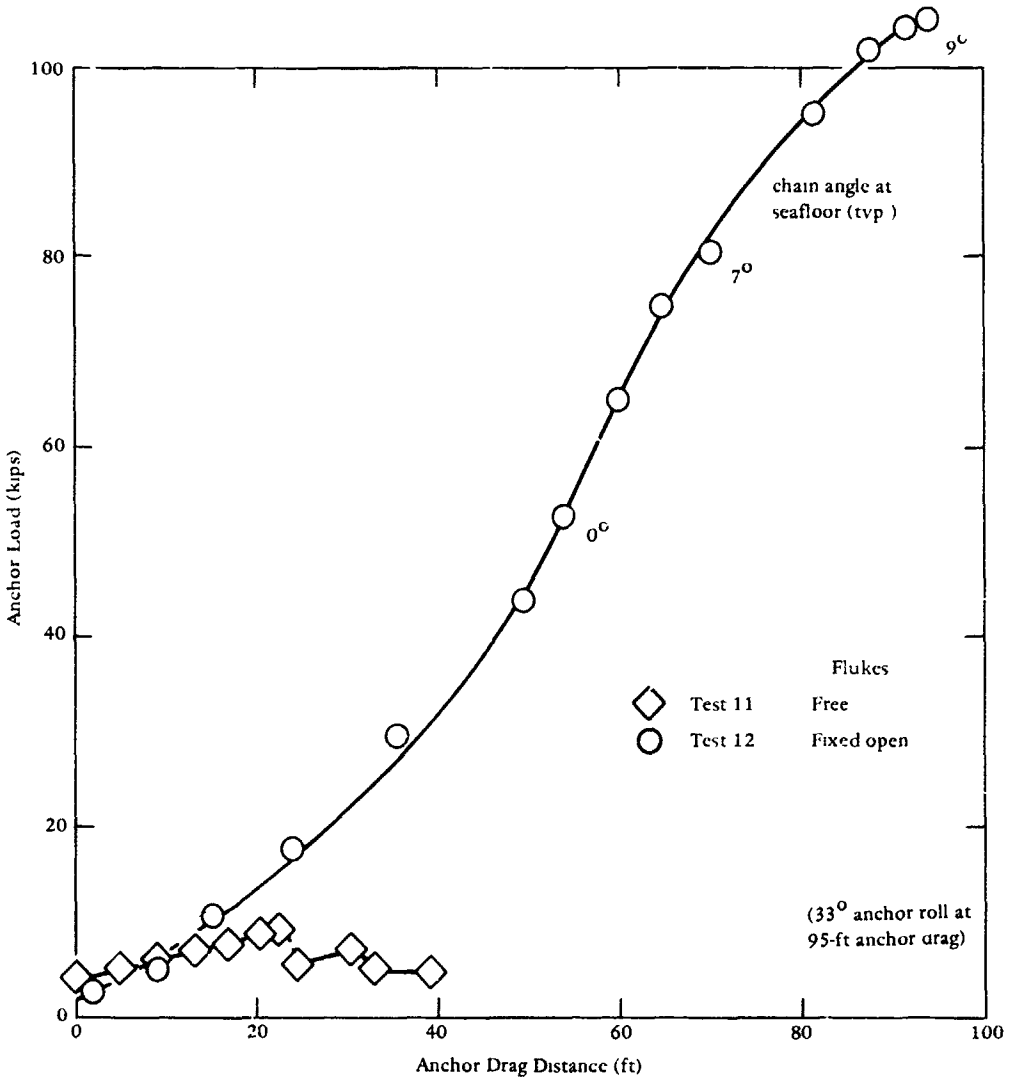


Figure 29. Anchor load versus drag distance for 11,000-pound STEVFIX.

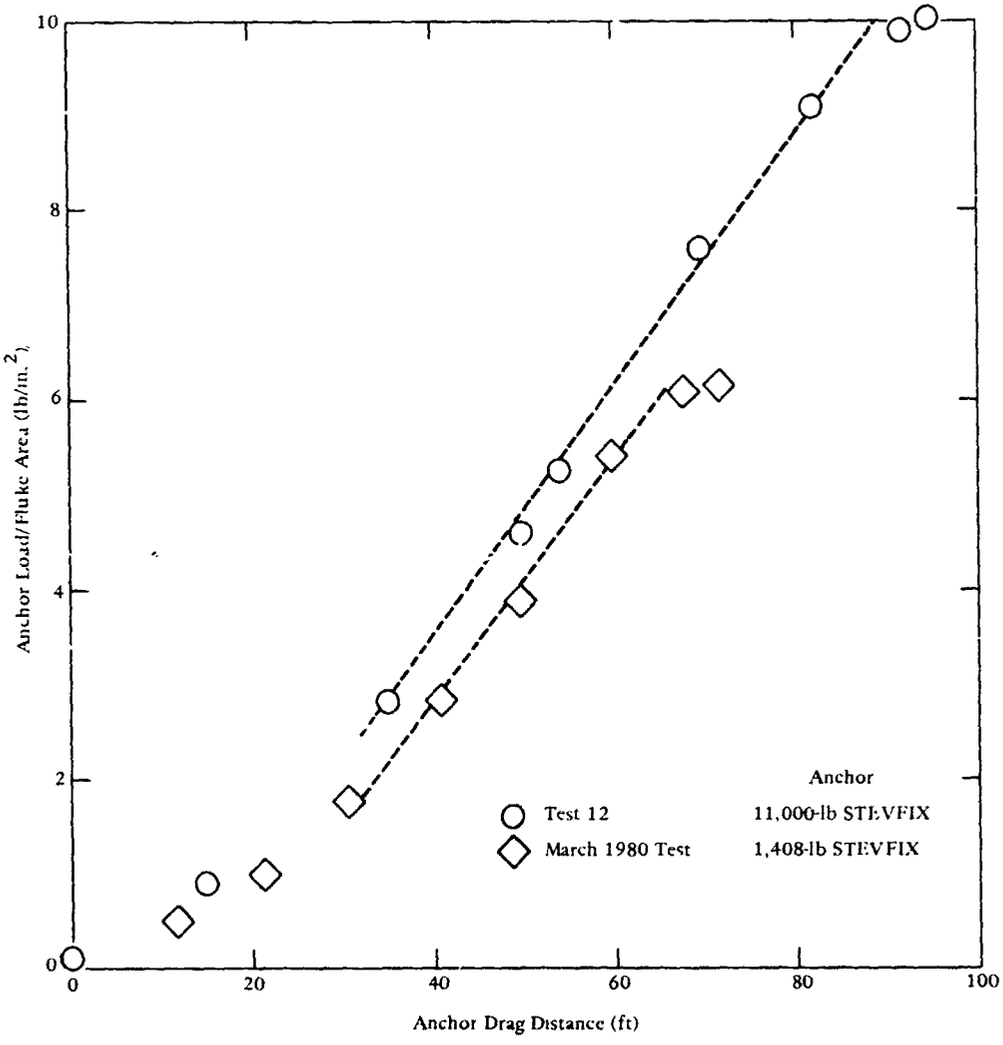
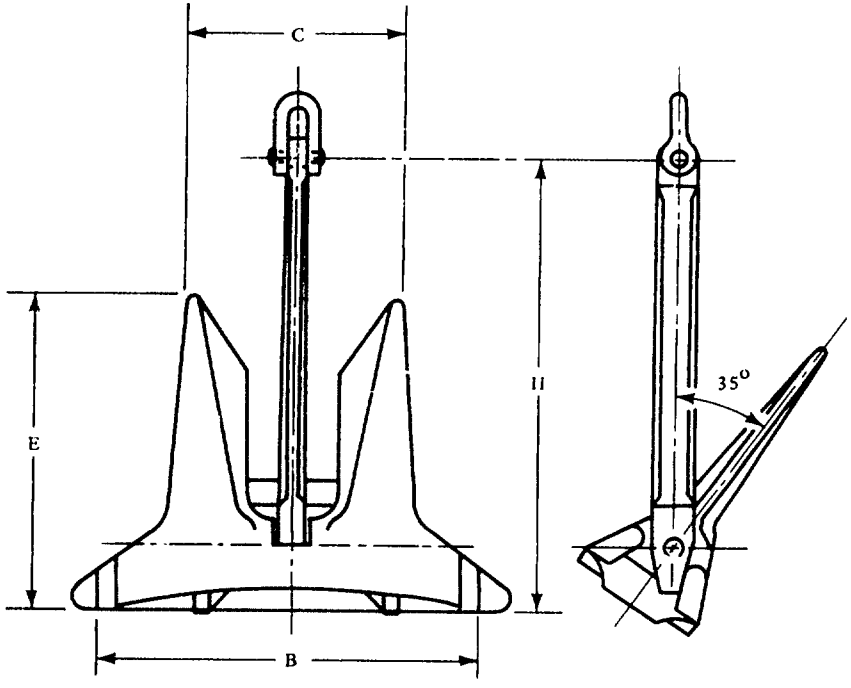


Figure 30. Anchor load normalized by fluke area for STEVFIX anchor with fixed-open flukes in mud.

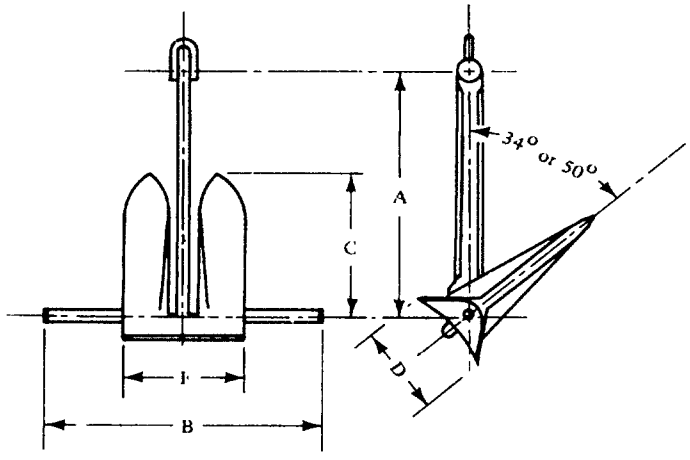
Appendix A

DIMENSIONS OF TESTED ANCHORS



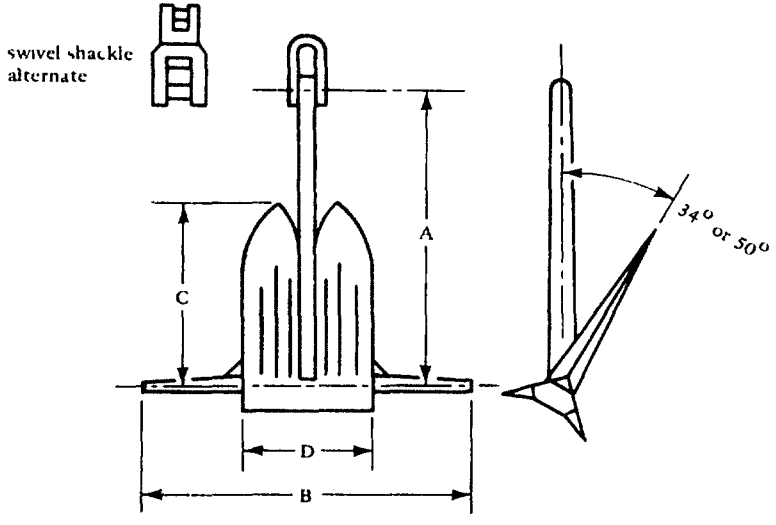
Anchor Weight, lb	Ball Guide Weight, lb	Dimensions, in. B	C	E	H
2,800	770	67	44	57	70
8,000	1 800	95	62	80	99

Figure A-1. Two-fluke balanced anchor.



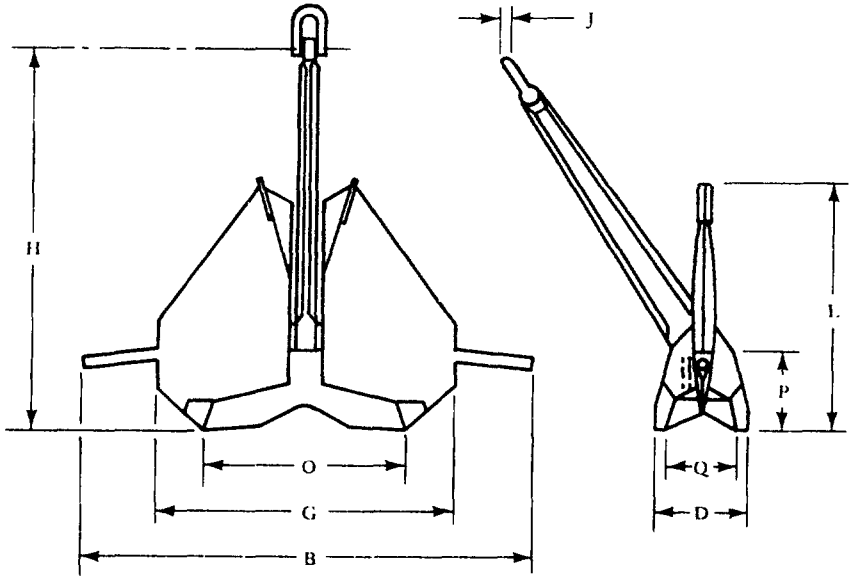
Anchor Weight, lb	Dimensions, in. A	B	C	D	E
1,000	61	75	37	19	25
3,000	88	109	54	27	37
6,000	101	143	61	31	42
8,000	122	153	75	38	51
10,000	131	157	80	41	55
12,000	139	167	85	43	58
14,000	147	177	90	45	61
16,000	153	187	94	48	64
20,000	164	196	102	51	69
30,000	189	217	118	59	79
40,000	214	248	127	63	86
50,000	222	257	132	66	89
60,000	232	271	140	70	95
70,000	244	274	147	73	100
80,000	255	298	154	77	105
90,000	266	310	160	80	109
100,000	275	320	166	83	113

Figure A-2. MOORFAST anchor.



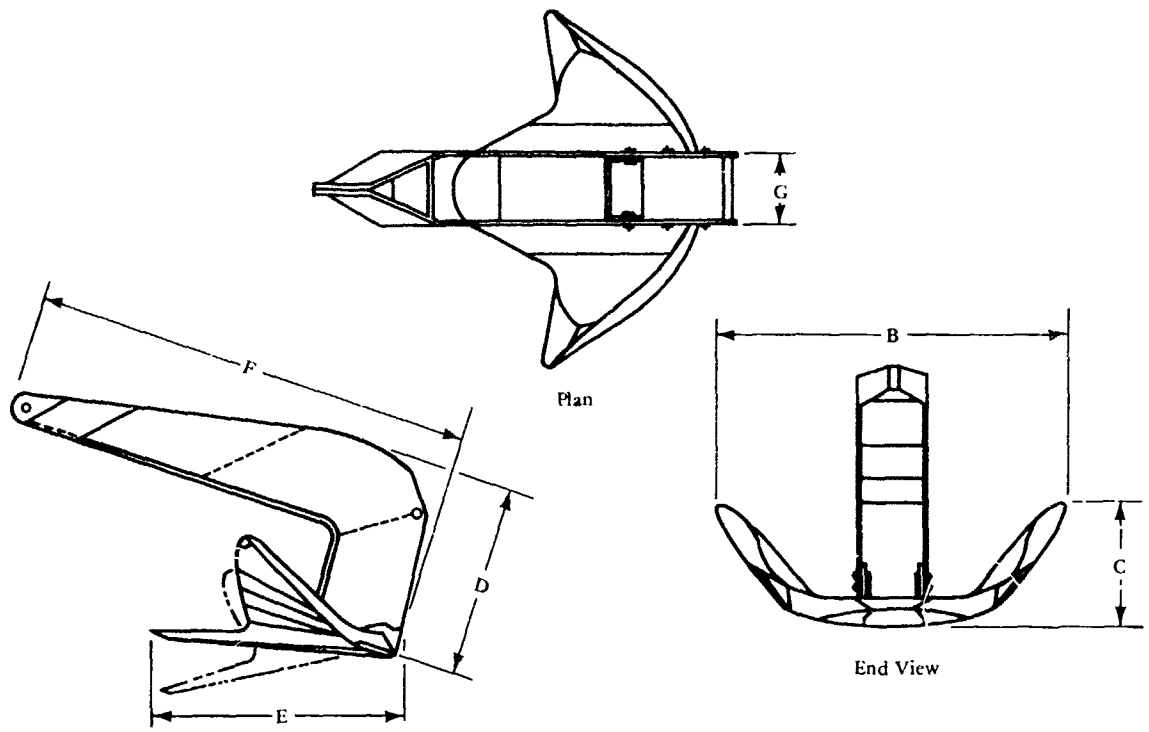
Anchor Weight, lb	Dimensions, in. A	B	C	D
200	42	59	26	23
1,000	80	80	43	28
3,000	129	109	69	41 5
6,000	144	143	82	55
9,000	160	170	96	62
12,000	186	197	108	69
15,000	204	224	121	76

Figure A-3. STATO anchor.



Anchor Weight, lb	Dimensions, in B	D	F	G	H	J	O	P	Q
2,200	114	25	66	76	99	2-9/16	53	19	19
3,300	131	28	75	87	113	2-15/16	61	21	21
6,600	165	36	94	109	142	3-9/16	76	27	27
11,000	195	43	112	130	169	3-15/16	91	33	32
15,400	218	47	125	145	189	4-3/4	101	37	36
19,850	237	52	136	158	205	5-1/8	110	40	39
26,450	261	57	150	174	226	5-1/2	121	44	43
33,100	281	61	162	187	244	5-7/8	131	47	46
44,100	309	67	178	206	268	6-11/16	144	52	51
66,150	355	77	204	236	307	7-7/8	165	59	58

Figure A-4. STEVFIX anchor.



Anchor Weight, lb	Dimensions, in. B	C	D	E	F	G
550	52	18	27	38	65	10-1/2
1,100	65	22	34	48	81	13
1,650	73	25	37	54	91	14-1/2
2,200	80	27	42	59	100	16
3,300	92	31	50	67	115	18-1/2
4,400	101	34	53	74	126	20-1/2
5,500	109	37	57	80	136	22
6,600	116	39	61	85	145	23-1/4
8,800	127	43	67	93	159	25-1/2
11,000	137	46	72	101	172	27-1/2
15,450	153	52	81	113	192	31
19,850	167	56	88	122	209	33-1/2
26,450	184	62	97	135	230	37
33,050	198	67	104	145	248	39-3/4
44,100	218	74	115	160	273	43-3/4
55,100	234	79	123	172	294	47-1/4

Figure A-5. BRUCE twin-shank anchor.

Appendix B

DATA FOR PORT HUENEME TESTS

Appendix B

DATA FOR PORT HUENEME TESTS

All data for the anchor tests performed at Port Hueneme are included in this appendix. Data are presented as plots and digitized listings of anchor performance. Anchor and deck tension, anchor crown penetration, chain weight on bottom, anchor shank pitch and anchor roll are plotted as functions of true anchor drag distance. Presented opposite each data plot is a digitized listing of all plotted data plus additional descriptive data that may be useful during data analysis. When data were not recovered due to instrumentation difficulties, straight lines with zero ordinates were plotted.

The lower block of all data plots provides anchor tension, deck tension, and chain weight on bottom. The difference between both tension measurements is attributed solely to chain drag both on and in the seafloor. The center block of the data plots provides anchor/shank roll. Shank pitch is plotted as a positive angle when shank tip is below shank crown. Both shank pitch and anchor/shank roll are limited to about ±45 degrees due to inclinometer limits. Anchor crown penetration is plotted in the top block versus anchor drag distance.

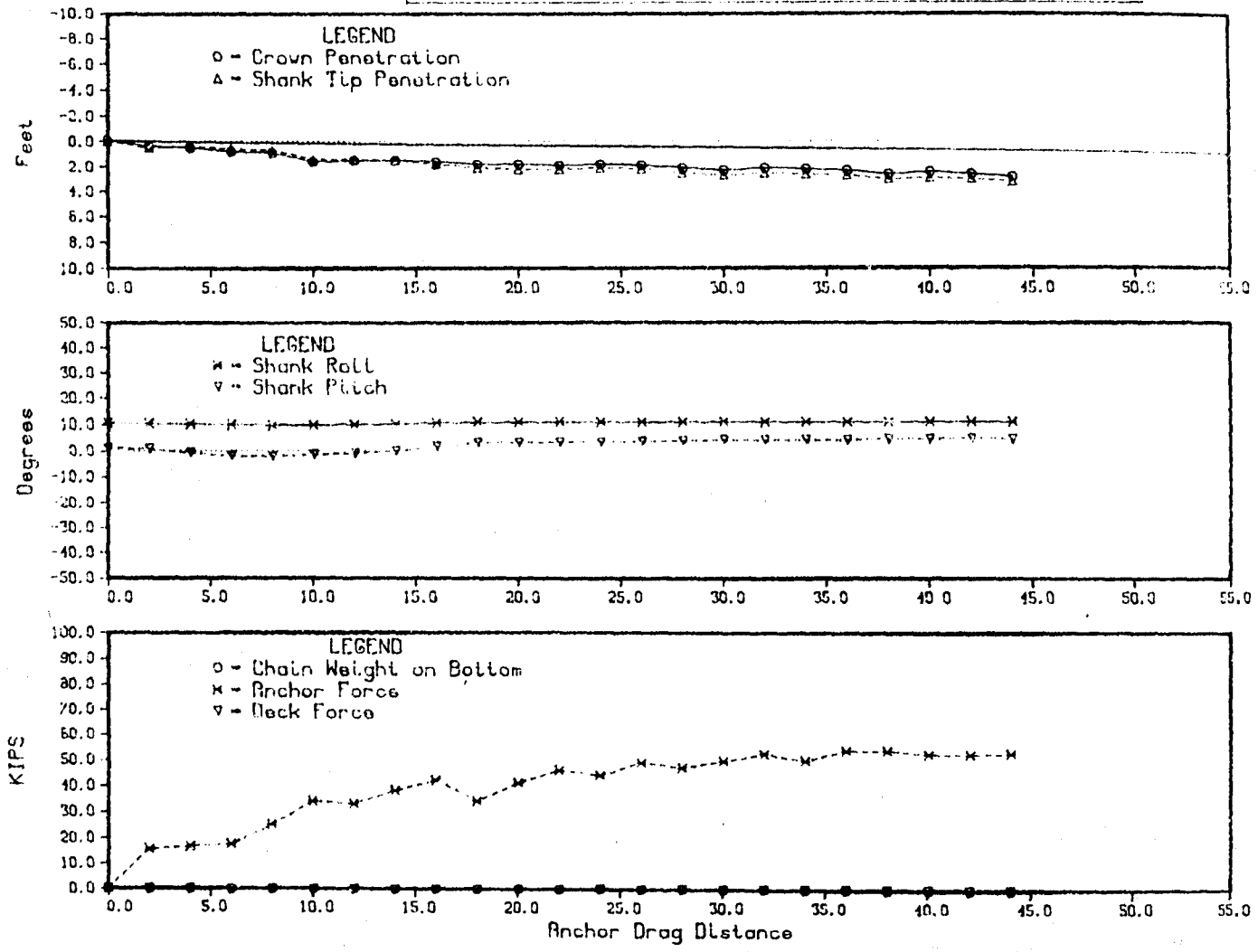
Some of the depth measurements shown seem questionable (note tests 6 and 7 where the shank tip moved above the seafloor). The seafloor did have an average slope of 1:50 and this could have varied locally, causing some of the sudden anchor depth changes that were recorded. The depths are referenced to an initial value taken by depth recorder and by leadline for backup. A 1:50 slope line is drawn on each test plot in this appendix to provide a better reference for anchor depths.

Of the tabulated data presented opposite the data plots, fluke tip depth, (item 13) should be used with caution. In sand, fluke opening is obvious; there is a sudden increase in shank angle associated with a gradual increase in anchor tension.

Day # - 303
Test No. - 1
Test Series No. - 0

WEST JETTY - PORT HUENEME

two fluke balanced w/ball guide 9800 lb, 40 deg mov flukes
port hueneme sand



TWO FLUKE ANCHOR TEST

TEST DATE	303
TEST NO.	1
TEST RUN	C
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	836 - 859
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	TWO FLUKE
ANCHOR WEIGHT	9800.00 LB.
FLUKE ANGLE-TYPE	50.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN C 170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WIR

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCHO
14. WATER
15. TOTAL

1	2	3	4	5	6	7	8	9	10	11
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET
0.0	*****	*****	45.9	10.6	1.1	10.4	*****	******	*******	45.7
2.0	*****	15.4	46.2	10.2	.3	7.4	*****	******	*******	46.2
4.0	*****	16.3	46.2	10.1	-.7	7.1	*****	******	*******	46.2
6.0	*****	17.9	46.4	9.9	-2.0	6.7	*****	******	*******	46.6
8.0	*****	20.0	46.5	9.6	-2.1	6.6	*****	******	*******	46.6
10.0	*****	34.0	47.2	9.5	-1.4	6.1	*****	******	*******	47.3
12.0	*****	33.0	47.2	9.8	-.9	6.0	*****	******	*******	47.3
14.0	*****	38.0	47.3	10.0	-.1	6.0	*****	******	*******	47.3
16.0	*****	42.0	47.5	10.5	1.6	5.7	*****	******	*******	47.4
18.0	*****	34.0	47.6	10.7	3.0	5.7	*****	******	*******	47.6
20.0	*****	41.0	47.6	10.7	3.1	5.4	*****	******	*******	47.6
22.0	*****	46.0	47.9	10.7	3.1	5.6	*****	******	*******	47.7
24.0	*****	44.0	47.8	10.7	3.2	5.7	*****	******	*******	47.5
26.0	*****	44.0	47.9	10.6	3.4	5.5	*****	******	*******	47.6
28.0	*****	47.0	48.1	10.7	3.7	5.5	*****	******	*******	47.9
30.0	*****	49.2	48.3	10.7	4.0	5.5	*****	******	*******	48.0
32.0	*****	52.5	48.2	10.7	4.0	5.5	*****	******	*******	47.9
34.0	*****	50.0	48.2	10.7	4.0	5.4	*****	******	*******	48.0
36.0	*****	54.0	48.3	10.7	4.0	5.6	*****	******	*******	48.1
38.0	*****	54.0	48.4	10.7	4.3	5.6	*****	******	*******	48.3
40.0	*****	52.5	48.3	10.8	4.3	5.6	*****	******	*******	48.2
42.0	*****	52.6	48.5	10.8	4.4	5.6	*****	******	*******	48.3
44.0	*****	53.0	48.5	10.8	4.3	5.5	*****	******	*******	48.5

DISTANCE ANCHOR TRAVELLED 44.0
DISTANCE ANCHOR TRAVELLED 44.0

2

TAO FLUKE ANCHOR TEST

303
1
0
WEST JETTY - PORT HUENEME
836 - 859
PORT HUENEME SAND
TAO FLUKE
9800.00 LB.
40.00 DEG. - 0 * 0=MOV 1=FIX
62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WIRE ROPE

9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

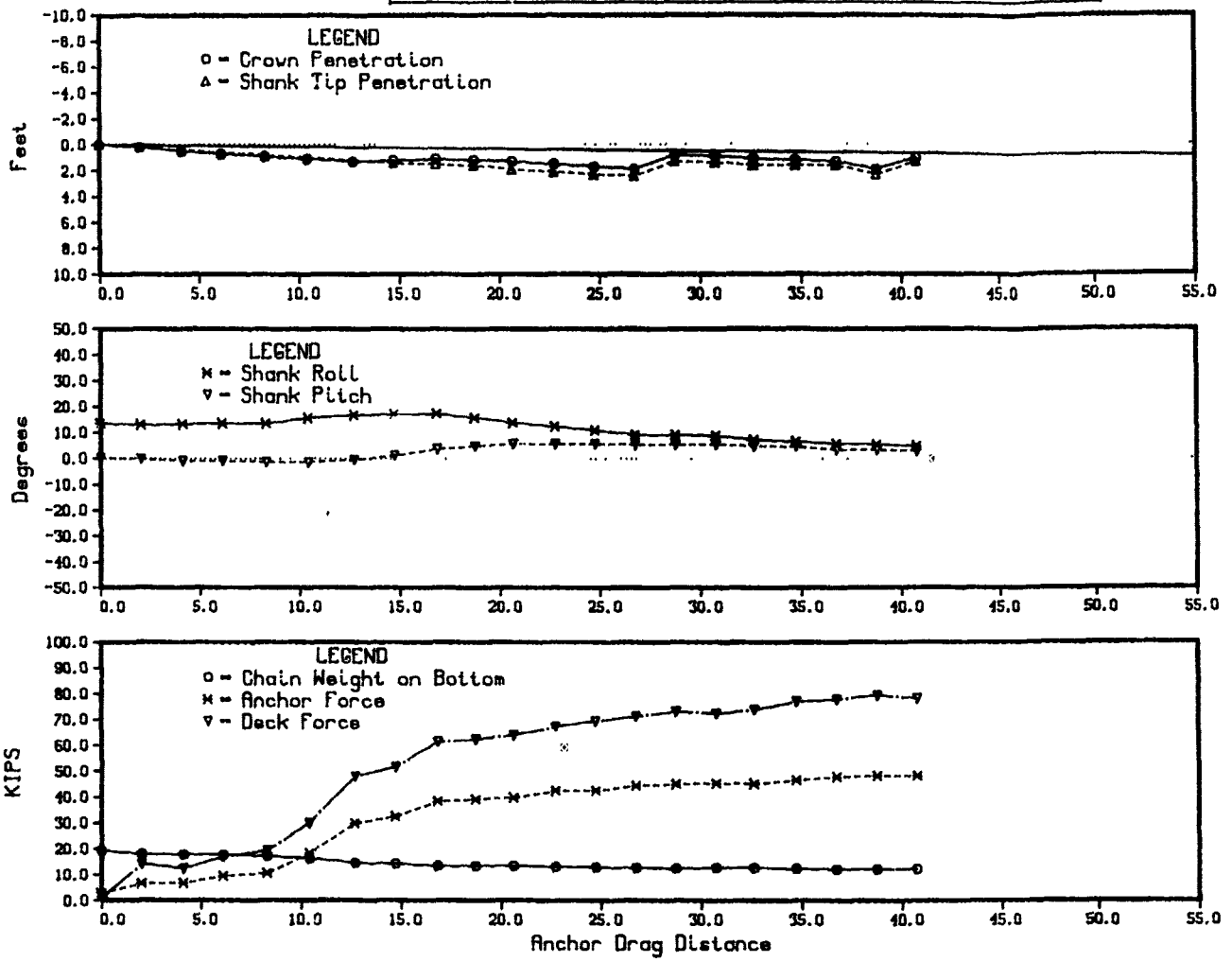
7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
10.4	*****	******	*******	45.7	45.8	48.5	45.8	*******
7.4	*****	******	*******	46.2	46.2	49.0	45.8	*******
7.1	*****	******	*******	46.2	46.2	49.0	45.8	*******
6.7	*****	******	*******	46.6	46.4	49.2	45.8	*******
6.6	*****	******	*******	46.6	46.4	49.3	45.8	*******
6.1	*****	******	*******	47.3	47.2	50.0	45.8	*******
6.0	*****	******	*******	47.3	47.2	50.0	45.8	*******
6.0	*****	******	*******	47.3	47.3	50.1	45.8	*******
5.7	*****	******	*******	47.4	47.5	50.3	45.8	*******
5.7	*****	******	*******	47.6	47.9	50.6	45.8	*******
5.4	*****	******	*******	47.6	47.9	50.6	45.8	*******
5.6	*****	******	*******	47.7	48.0	50.6	45.8	*******
5.7	*****	******	*******	47.5	47.9	50.5	45.8	*******
5.5	*****	******	*******	47.6	48.0	50.6	45.8	*******
5.5	*****	******	*******	47.9	48.3	50.9	45.8	*******
5.5	*****	******	*******	48.0	48.4	51.1	45.8	*******
5.5	*****	******	*******	47.9	48.3	50.9	45.8	*******
5.4	*****	******	*******	48.0	48.4	51.0	45.8	*******
5.6	*****	******	*******	48.1	48.5	51.1	45.8	*******
5.6	*****	******	*******	48.3	48.7	51.3	45.8	*******
5.6	*****	******	*******	48.2	48.6	51.2	45.8	*******
5.6	*****	******	*******	48.3	48.8	51.4	45.8	*******
5.5	*****	******	*******	48.5	49.0	51.6	45.8	*******

3

Day # - 303
Test No. - 2
Test Series No. - 0

WEST JETTY - PORT HUENEME

two fluke balanced w/ball guide 9800 lb, 40 deg mov flukes
port hueneme sand



TWO FLUKE ANCHOR TEST

TEST DATE	303
TEST NO.	2
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1104 - 1117
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	TWO FLUKE
ANCHOR WEIGHT	9800.00 LB.
FLUKE ANGLE-TYPE,	40.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	52 FT - 2.25 IN CHAIN, 84 FT - 2.
	170 FT - 2.875 IN CHAIN, 34 FT -

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. LINE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM 1
10. CHAIN WEIGHT ON BOTTOM 1
11. ANCHOR CROWN DEPTH 1
12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS
0.0	.6	2.9	45.4	13.5	.2	7.9	.8	644.0	19215.0
2.0	14.1	6.7	45.6	13.0	-.2	5.7	14.1	441.4	17916.4
4.1	12.5	5.9	45.6	13.3	-.9	6.6	12.4	439.0	17901.3
6.1	17.0	9.5	46.1	13.6	-.9	5.7	16.9	396.6	17629.3
8.3	19.5	10.6	46.3	13.9	-1.3	6.2	19.4	332.8	17220.1
10.4	30.2	16.3	46.5	15.6	-1.4	5.6	30.0	303.2	16262.9
12.7	46.4	29.9	46.7	16.7	-.5	5.7	46.1	276.6	14492.9
14.7	51.9	32.5	46.7	17.0	1.2	5.6	51.7	273.5	14284.0
16.8	61.7	38.3	46.6	17.2	3.7	5.6	61.4	259.3	13338.9
18.7	62.6	39.1	46.9	15.7	4.8	5.4	62.4	260.9	13446.5
20.6	64.3	39.8	47.1	13.9	5.7	5.2	64.1	261.4	13477.8
22.7	67.6	42.4	47.3	12.3	5.6	5.3	67.3	255.6	13095.3
24.7	69.4	42.5	47.5	10.9	5.6	5.3	69.5	252.7	12898.9
26.7	71.6	44.4	47.6	9.2	5.4	5.3	71.3	249.9	12715.9
28.7	73.6	45.1	46.5	9.1	5.4	5.3	73.3	246.9	12515.6
30.7	72.7	45.3	46.6	8.3	5.4	5.2	72.4	250.8	12770.5
32.6	74.1	45.1	46.6	7.1	4.7	5.1	73.8	249.5	12689.3
34.7	77.4	46.5	46.9	6.5	4.6	5.1	77.1	245.1	12394.5
36.7	78.3	47.9	46.9	5.7	3.3	5.2	78.0	243.7	12299.4
38.7	79.9	48.3	47.6	5.3	3.3	5.2	79.5	241.6	12161.2
40.7	78.7	48.2	46.6	4.7	2.8	5.2	78.4	243.2	12268.0

DISTANCE RANGE TRAVELLED 40.0
DISTANCE ANCHOR TRAVELLED 40.7

2

FLUKE ANCHOR TEST

TY - PORT HUENEME
17
NEME SAND

) LB.
5. - 0 0=MOV 1=FIX
2.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
2.875 IN CHAIN, 34 FT - 2 IN WIRE ROPE

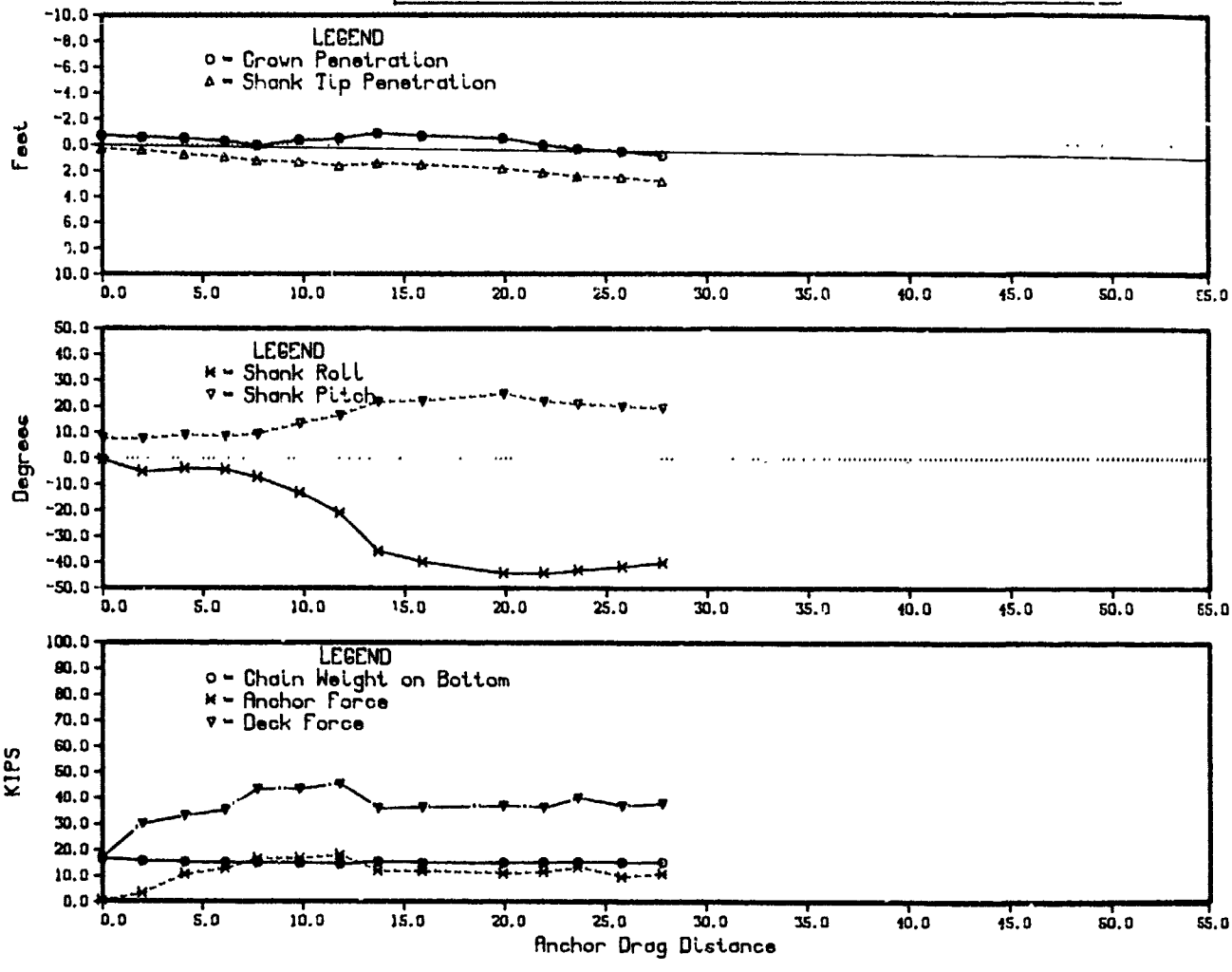
ANCH CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
WATE CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
TOTA ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
ANCHOR SHANK TIP DEPTH CROWN

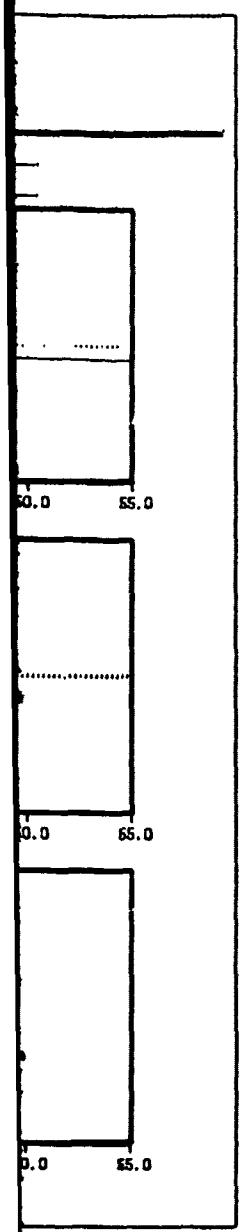
8	9	10	11	12	13	14	15
IPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
.8	644.0	19215.0	45.4	45.4	48.2	45.4	29015.0
4.1	441.4	17916.4	45.6	45.6	48.4	45.4	27716.4
2.4	439.0	17901.3	45.9	45.8	48.6	45.4	27701.3
6.9	396.6	17629.3	46.1	46.1	48.9	45.4	27429.3
9.4	332.8	17220.1	46.3	46.2	49.0	45.4	27020.1
0.0	303.2	16262.9	46.5	46.4	49.2	45.4	26062.9
8.1	276.6	14492.9	46.7	46.7	49.4	45.4	24292.9
1.7	273.5	14284.0	46.7	46.8	49.4	45.4	24084.0
1.4	259.3	13338.9	46.5	46.9	49.4	45.4	23138.9
2.4	260.9	13446.5	46.6	47.1	49.6	45.4	23246.5
4.1	261.4	13477.8	46.8	47.3	49.8	45.4	23277.8
7.3	255.6	13095.3	46.9	47.5	50.0	45.4	22895.3
9.5	252.7	12898.9	47.1	47.7	50.2	45.4	22698.9
1.3	249.9	12715.9	47.3	47.8	50.4	45.4	22515.9
3.3	246.9	12515.6	46.2	46.7	49.3	45.4	22315.6
2.4	250.8	12770.5	46.3	46.8	49.4	45.4	22570.5
3.8	249.5	12689.3	46.5	47.0	49.6	45.4	22489.3
7.1	245.1	12394.5	46.6	47.1	49.7	45.4	22194.5
8.0	243.7	12299.4	46.7	47.0	49.7	45.4	22099.4
9.5	241.6	12161.2	47.4	47.7	50.4	45.4	21961.2
8.4	243.2	12268.0	46.4	46.7	49.4	45.4	22068.0

Day # - 303
Test No. - 3
Test Series No. - 0

WEST JETTY - PORT HUENEME

moorfast 3000 lb, 34 degree movable flukes
port hueneme sand





MOORFAST ANCHOR TEST

TEST DATE	303
TEST NO.	3
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1405 - 1417
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	MOORFAST
ANCHOR WEIGHT	3000.00 LB.
FLUKE ANGLE-TYPE,	34.00 DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 170 FT - 2.875 IN CHAIN, 34 FT

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS
0.0	17.3	.4	42.2	-.7	7.6	8.4	17.1	311.4	16803.3
2.0	30.3	3.4	42.3	-5.1	7.5	6.6	30.1	296.7	15827.6
4.1	33.4	10.6	42.6	-3.9	9.0	6.6	33.2	291.6	15491.7
6.1	35.7	12.9	42.8	-4.4	8.5	6.5	35.5	289.0	15312.8
7.7	43.8	16.8	43.1	-7.3	9.4	5.3	43.6	288.7	15298.1
9.8	43.8	16.9	43.1	-13.2	13.5	5.6	43.6	285.7	15097.4
11.8	45.7	18.0	43.2	-20.9	16.6	5.6	45.5	282.6	14887.9
13.7	36.3	12.0	43.0	-35.6	21.9	5.7	36.1	295.3	15736.5
15.9	36.9	12.0	43.1	-39.6	22.3	6.2	36.6	289.9	15376.4
19.9	37.3	11.2	43.4	-44.0	25.0	6.1	37.1	289.9	15377.7
21.9	36.6	11.7	43.7	-43.8	22.1	6.0	36.4	291.8	15502.7
23.6	40.3	13.6	44.0	-42.8	21.1	5.3	40.1	293.0	15582.8
25.8	37.3	9.9	44.1	-41.4	20.2	5.9	37.1	291.4	15475.9
27.8	38.3	11.0	44.5	-40.0	19.5	5.8	38.1	291.6	15491.7

DISTANCE BARGE TRAVELLED 28.0
DISTANCE ANCHOR TRAVELLED 27.3

2

FAST ANCHOR TEST

Y - PORT HUENEME
17
EME SAND

LB.
. - 1 0=MOV 1=FIX
.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
- 2.1 2.875 IN CHAIN, 34 FT - 2 IN WIRE ROPE
T - 2

HAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
M 13 HAIN WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
M 14 NCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
15 NCHOR SHANK TIP DEPTH CROWN
H

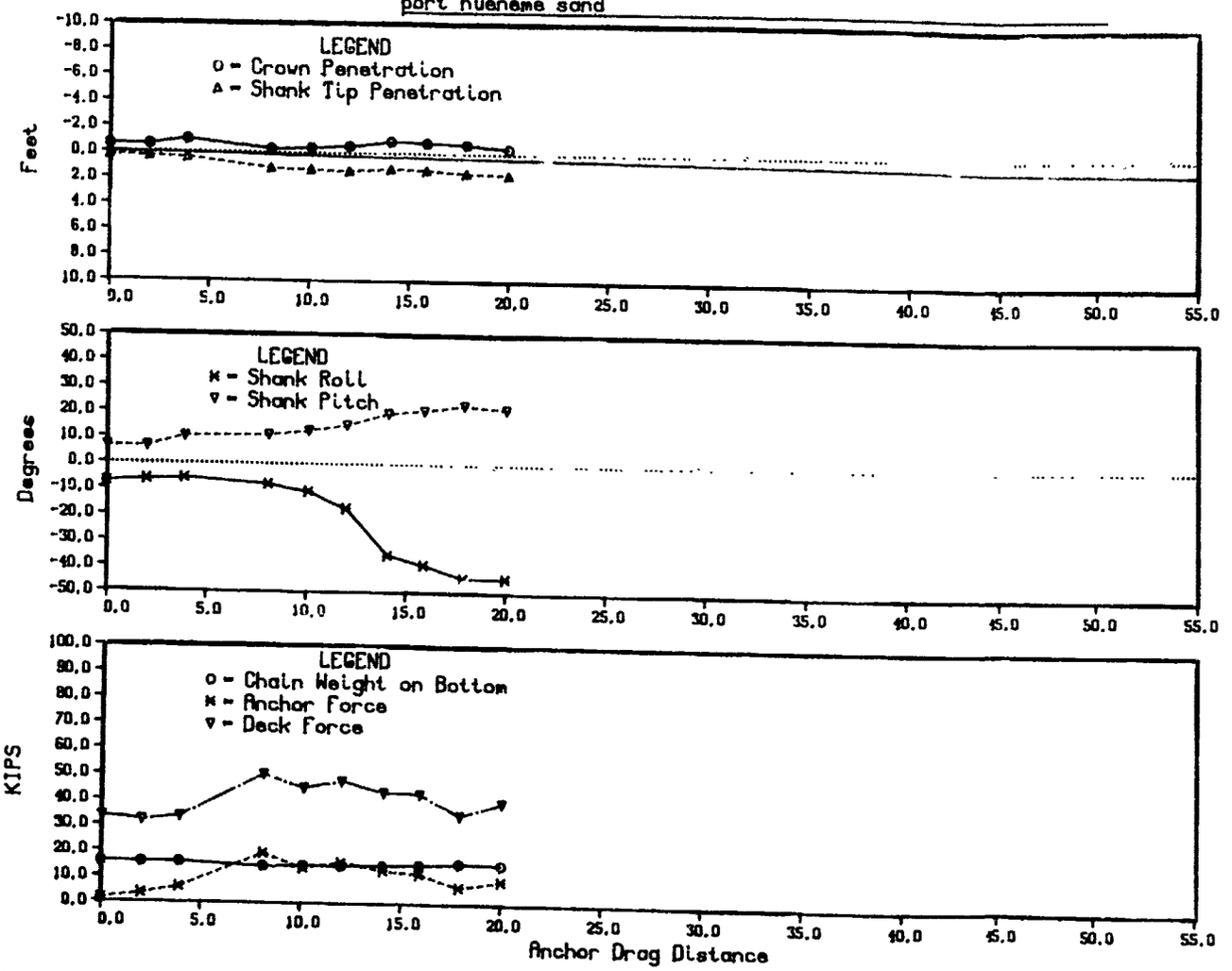
	8	9	10	11	12	13	14	15
	IPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
F	7.1	311.4	16803.3	41.4	42.4	44.4	42.2	19803.3
4	0.1	296.7	15827.6	41.6	42.6	44.6	42.2	18827.6
4	3.2	291.6	15491.7	41.7	42.9	44.8	42.2	18491.7
4	5.5	289.0	15312.8	41.9	43.1	45.0	42.2	18312.8
4	3.6	288.7	15298.1	42.1	43.4	45.2	42.2	18298.1
4	3.6	285.7	15097.4	41.8	43.5	45.0	42.2	18097.4
4	5.5	282.6	14887.9	41.7	43.8	45.0	42.2	17887.9
4	6.1	295.3	15736.5	41.2	43.6	44.3	42.2	18736.5
4	6.5	289.9	15376.4	41.5	43.7	44.4	42.2	18376.4
4	7.1	289.9	15377.7	41.7	44.0	44.4	42.2	18377.7
4	6.4	291.8	15502.7	42.2	44.3	44.9	42.2	18502.7
4	0.1	293.0	15582.8	42.5	44.5	45.2	42.2	18582.8
4	7.1	291.4	15475.9	42.7	44.6	45.4	42.2	18475.9
4	8.1	291.6	15491.7	43.0	45.0	45.8	42.2	18491.7
4								

3

Day # - 303
Test No. - 4
Test Series No. - 0

WEST JETTY - PORT HUENEME

moorfast 3000 lb, 34 degree movable flukes
port hueneme sand



MOORFAST ANCHOR TEST

TEST DATE	303
TEST NO.	4
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1541 - 1548
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	MOORFAST
ANCHOR WEIGHT	3000.00 LB.
FLUKE ANGLE-TYPE,	34.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.18
	170 FT - 2.875 IN CHAIN, 34 FT - 2

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13.
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14.
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15.
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEE
0.0	33.5	1.4	40.6	-7.2	6.4	5.6	33.4	300.2	16064.4	40.
2.0	32.3	3.5	40.6	-6.3	6.4	6.0	32.1	298.8	15970.1	40.
3.9	33.7	6.1	40.6	-5.8	10.4	5.8	33.5	298.4	15938.7	39.
8.1	50.3	19.3	41.4	-8.0	11.1	5.5	50.0	276.4	14478.4	40.
10.1	45.2	13.9	41.5	-10.8	12.8	5.6	45.0	282.9	14908.1	40.
12.0	47.9	16.0	41.5	-17.2	15.0	5.4	47.7	281.2	14796.9	40.
14.1	43.6	13.0	41.2	-35.3	19.6	5.6	43.4	285.0	15047.6	39.
15.9	43.1	11.8	41.3	-39.0	20.8	5.4	42.9	288.4	15278.3	39.
17.9	35.0	6.8	41.5	-44.1	23.0	5.6	34.8	298.0	15914.0	39.
20.0	39.8	9.2	41.7	-44.0	21.6	5.6	39.6	290.7	15426.0	40.

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 20.0

2

ANCHOR TEST

RT HUENEME

ND

0=MOV 1=FIX
CHAIN, 84 FT - 2.185 IN CHAIN
IN CHAIN, 34 FT - 2 IN WIRE ROPE

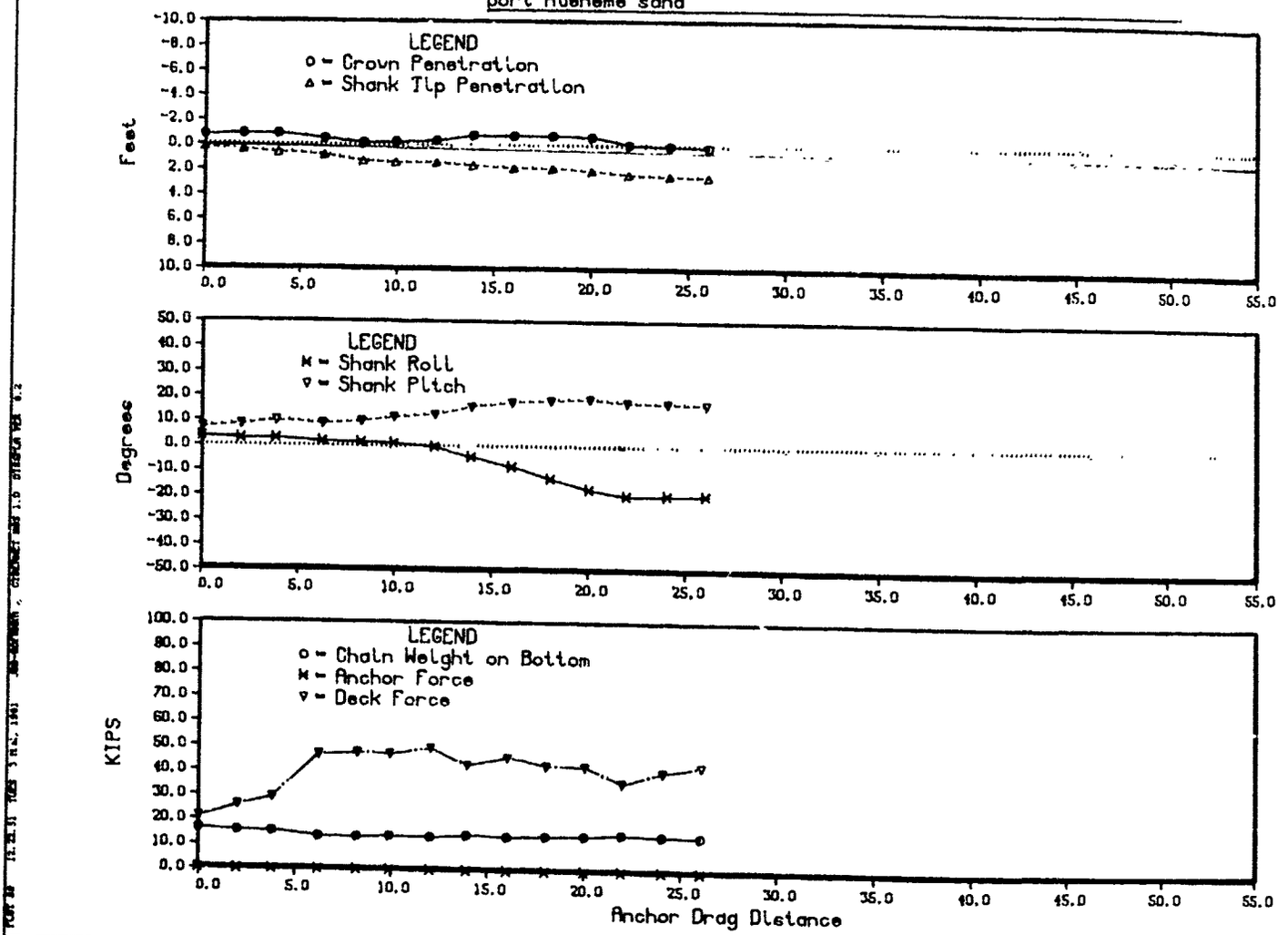
ENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
EIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
SHANK TIP DEPTH CROWN

9	10	11	12	13	14	15
FEET	LBS	FEET	FEET	FEET	FEET	LBS
300.2	16064.4	40.0	40.8	42.9	40.6	19064.4
298.8	15970.1	40.0	40.9	42.9	40.6	18970.1
298.4	15938.7	39.6	41.0	42.7	40.6	18938.7
276.4	14478.4	40.3	41.8	43.5	40.6	17478.4
282.9	14908.1	40.2	41.9	43.4	40.6	17908.1
281.2	14796.9	40.1	42.0	43.3	40.6	17796.9
285.0	15047.6	39.7	41.8	42.6	40.6	18047.6
288.4	15278.3	39.8	41.9	42.6	40.6	18278.3
298.0	15914.0	39.9	42.1	42.6	40.6	18914.0
290.7	15426.0	40.1	42.2	42.8	40.6	18426.0

Day # - 304
Test No. - 5
Test Series No. - 0

WEST JETTY - PORT HUENEME

moorfast 6000 lb, 34 degree movable flukes
port hueneme sand



MOORFAST ANCHOR TEST

TEST DATE	304
TEST NO.	5
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	910 - 924
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	MOORFAST
ANCHOR WEIGHT	6000.00 LB.
FLUKE ANGLE-TYPE,	34.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185
	170 FT - 2.875 IN CHAIN, 34 FT - 2 I

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEE
0.0	21.3	*****	40.3	3.6	7.2	7.5	21.1	307.6	16554.3	39.
2.0	26.1	*****	40.4	2.9	8.5	7.7	25.9	296.6	15820.0	39.
3.8	29.5	*****	40.6	3.0	10.3	7.2	29.3	294.1	15655.0	39.
6.2	47.0	*****	40.8	2.0	9.0	7.0	46.7	263.1	13589.7	39.
8.2	47.9	*****	41.3	1.6	10.0	6.9	47.6	262.3	13540.4	40.
9.9	47.2	*****	41.4	1.1	11.6	6.6	46.9	268.2	13928.9	40.
12.0	49.6	*****	41.3	-.2	12.6	6.7	49.3	262.8	13573.4	39.
13.9	43.1	*****	41.4	-4.2	16.0	6.7	42.8	273.7	14299.3	39.
16.0	46.2	*****	41.5	-8.1	17.9	6.7	45.9	268.2	13928.9	39.
18.0	43.1	*****	41.6	-12.7	18.7	6.8	42.8	272.7	14231.3	39.
20.0	42.7	*****	41.7	-17.0	19.3	6.8	42.4	273.5	14285.7	39.
21.9	36.0	*****	42.1	-19.5	17.9	6.9	35.8	284.2	14994.6	40.
24.0	40.6	*****	42.2	-19.3	17.6	6.9	40.3	276.1	14456.6	40.
26.0	43.1	*****	42.3	-19.2	17.3	6.8	42.8	272.4	14209.7	40.

DISTANCE BARGE TRAVELLED 26.0
DISTANCE ANCHOR TRAVELLED 26.0

2

MOOREAST ANCHOR TEST

JETTY - PORT HUENEME
- 924
HUENEME SAND
AST
0.00 LB.
DEG. - 0 0=MOV 1=FIX
- 2.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
T - 2.875 IN CHAIN, 34 FT - 2 IN WIRE ROPE

9. CHAIN LENGTH ON BOTTOM
0. CHAIN WEIGHT ON BOTTOM
1. ANCHOR CROWN DEPTH
2. ANCHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

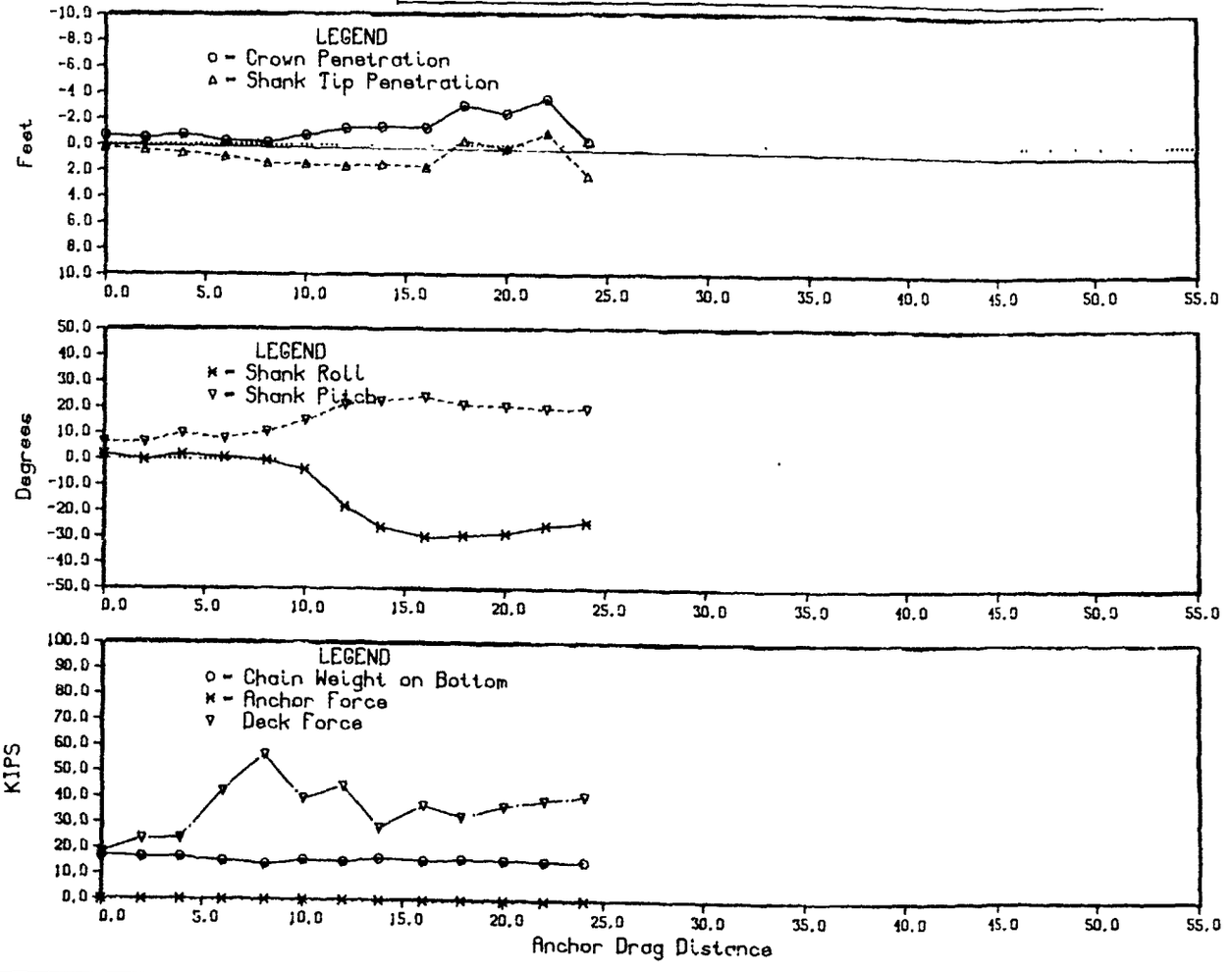
8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
21.1	307.6	16554.3	39.5	40.6	42.8	40.3	22554.3
25.9	296.6	15820.0	39.5	40.7	42.9	40.3	21820.0
29.3	294.1	15655.0	39.4	40.9	43.0	40.3	21655.0
46.7	263.1	13589.7	39.8	41.1	43.3	40.3	19589.7
47.6	262.3	13540.4	40.1	41.6	43.7	40.3	19540.4
46.9	268.2	13928.9	40.1	41.8	43.7	40.3	19928.9
49.3	262.8	13573.4	39.9	41.8	43.6	40.3	19573.4
42.8	273.7	14299.3	39.6	41.9	43.5	40.3	20299.3
45.9	268.2	13928.9	39.5	42.1	43.5	40.3	19928.9
42.8	272.7	14231.3	39.5	42.2	43.4	40.3	20231.3
42.4	273.5	14285.7	39.6	42.3	43.5	40.3	20285.7
35.8	284.2	14994.6	40.2	42.6	44.0	40.3	20994.6
40.3	276.1	14456.6	40.3	42.8	44.1	40.3	20456.6
42.8	272.4	14209.7	40.4	42.8	44.2	40.3	20209.7

3

Day # - 304
Test No. - 6
Test Series No. - 0

WEST JETTY - PORT HUENEME

moorfast 6000 Lb, 34 degree movable flukes
port hueneme sand



MOORFAST ANCHOR TEST

TEST DATE	304
TEST NO.	6
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	957 - 1007
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	MOORFAST
ANCHOR WEIGHT	6000.00 LB.
FLUKE ANGLE-TYPE,	34.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
	170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WIRE ROP

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. ANCHOR FLU
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. WATER DEPT
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. TOTAL BOTT
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET
0.0	18.5	*****	39.3	1.6	6.5	7.2	18.4	314.7	17024.2	38.6	39.6
2.0	23.7	*****	39.6	-.4	6.4	6.6	23.5	308.2	16591.3	38.8	39.8
3.9	23.9	*****	39.6	1.7	9.9	6.4	23.7	309.3	16665.7	38.5	40.0
6.0	42.5	*****	40.0	.7	7.9	5.6	42.3	287.1	15192.6	39.1	40.3
8.1	56.7	*****	40.4	-.5	10.7	5.6	56.5	266.9	13844.0	39.1	40.7
10.0	39.7	*****	40.4	-4.1	14.9	5.7	39.5	290.6	15422.0	38.7	40.9
12.0	44.7	*****	40.3	-18.0	21.3	5.6	44.5	283.3	14935.6	38.1	41.0
13.8	28.7	*****	40.2	-25.9	22.5	5.7	28.6	306.2	16461.1	37.9	40.
16.0	37.3	*****	40.4	-29.8	24.2	5.8	37.1	292.6	15553.3	38.0	41.0
17.9	33.0	*****	38.4	-29.4	21.1	5.8	32.8	299.1	15988.3	36.4	39.0
20.0	37.0	*****	39.0	-28.5	20.7	5.8	36.8	293.7	15626.6	37.0	39.6
22.0	39.4	*****	37.9	-25.5	19.7	5.8	39.2	289.7	15365.4	35.9	38.4
24.0	41.0	*****	41.1	-24.4	19.5	5.8	40.8	287.4	15212.6	39.1	41.7

DISTANCE BARGE TRAVELLED 24.0
DISTANCE ANCHOR TRAVELLED 24.0

2

TEST

ME

1=FIX
84 FT - 2.185 IN CHAIN
, 34 FT - 2 IN WIRE ROPE

N BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
N BOTTOM 14. WATER DEPTH ANGLE INDICATES
EPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
IP DEPTH CROWN

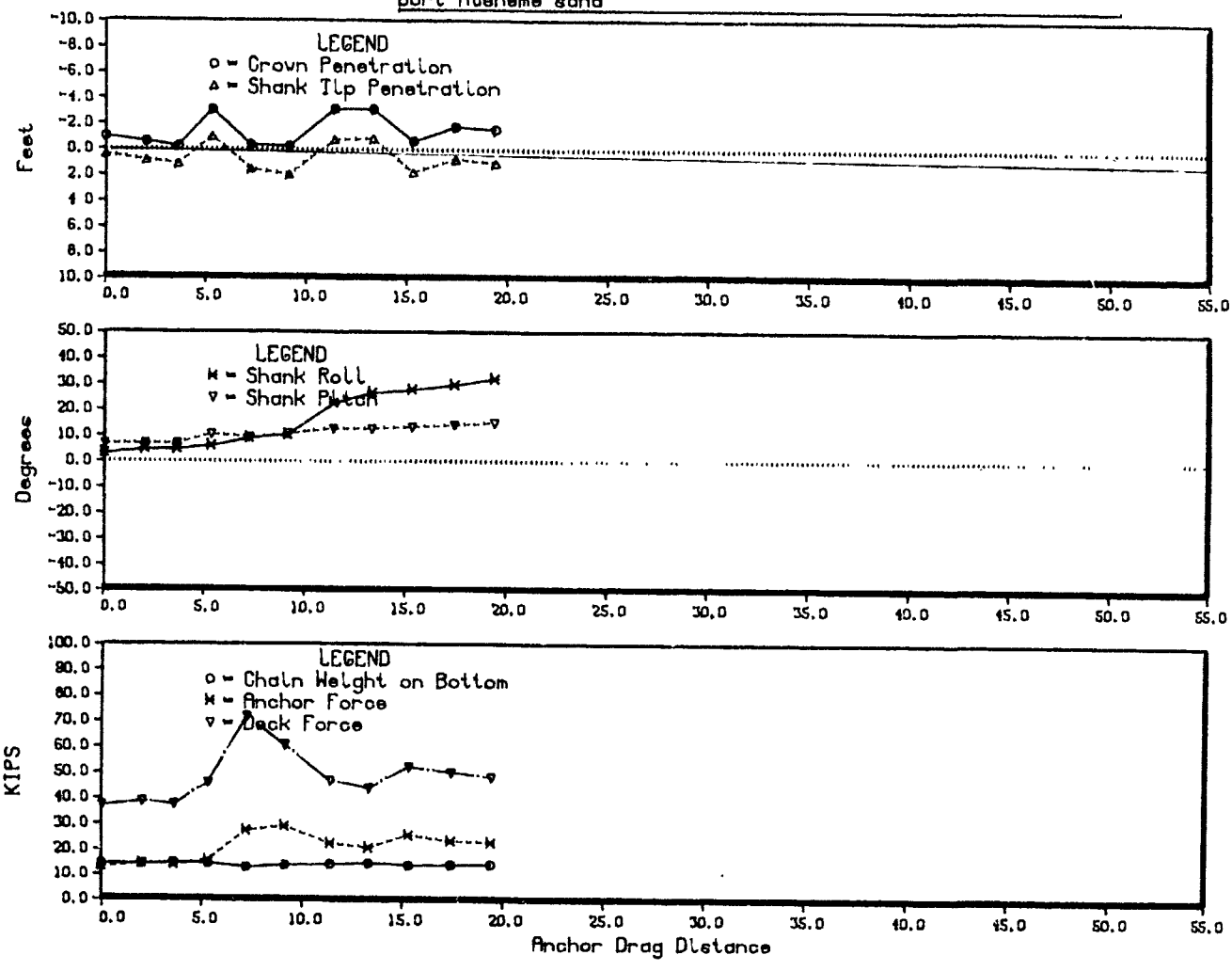
10	11	12	13	14	15
LBS	FEET	FEET	FEET	FEET	LBS
17024.2	38.6	39.6	41.9	39.3	23024.2
16591.3	38.8	39.8	42.1	39.3	22591.3
16665.7	38.5	40.0	42.0	39.3	22665.7
15192.6	39.1	40.3	42.5	39.3	21192.6
13844.0	39.1	40.7	42.7	39.3	19844.0
15422.0	38.7	40.9	42.5	39.3	21422.0
14935.6	38.1	41.0	42.0	39.3	20935.6
16461.1	37.9	40.9	41.7	39.3	22461.1
15553.3	38.0	41.0	41.8	39.3	21553.3
15988.3	36.4	39.0	40.0	39.3	21988.3
15626.6	37.0	39.6	40.6	39.3	21626.6
15365.4	35.9	38.4	39.6	39.3	21365.4
15212.6	39.1	41.7	42.8	39.3	21212.6

3

Day # = 304
Test No. = 7
Test Series No. = 0

WEST JETTY - PORT HUENEME

stato 3500 lb, 32 degree movable flukes
port hueneme sand



STATO ANCHOR TEST

TEST DATE	304
TEST NO.	7
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1146 - 1157
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	STATO
ANCHOR WEIGHT	3500.00 LB.
FLUKE ANGLE-TYPE,	32.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 I
	170 FT - 2.875 IN CHAIN, 34 FT - 2 IN

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. AN
14. WA
15. TO

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	37.5	13.0	41.0	3.0	6.8	7.5	37.2	275.8	14437.1	40.0
2.0	39.2	14.5	41.4	4.6	7.0	7.2	38.9	275.8	14435.4	40.4
3.6	38.0	14.0	41.7	4.9	6.9	6.5	37.8	285.0	15046.4	40.7
5.3	46.4	16.0	39.4	6.2	10.5	5.7	46.1	279.8	14701.9	37.9
7.2	72.2	27.6	41.9	9.2	9.3	4.9	72.0	257.0	13185.2	40.6
9.1	61.2	29.2	42.2	10.5	10.8	4.9	60.9	271.1	14127.7	40.7
11.4	47.4	22.6	39.5	22.8	12.8	5.8	47.1	276.9	14510.6	37.8
13.3	44.5	21.0	39.4	26.7	12.8	5.8	44.2	282.4	14875.2	37.8
15.3	52.9	26.0	42.0	28.0	13.6	5.5	52.6	273.2	14264.2	40.3
17.4	50.6	23.7	41.0	29.6	14.3	5.7	50.3	273.6	14288.4	39.2
19.4	48.6	23.0	41.3	32.2	15.2	5.7	48.6	276.3	14472.3	39.4

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 19.4

2

CHOR TEST

UENEME

=MOV 1=FIX
IN, 84 FT - 2.185 IN CHAIN
HAIN, 34 FT - 2 IN WIRE ROPE

H ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
T ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
N DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
K TIP DEPTH CROWN

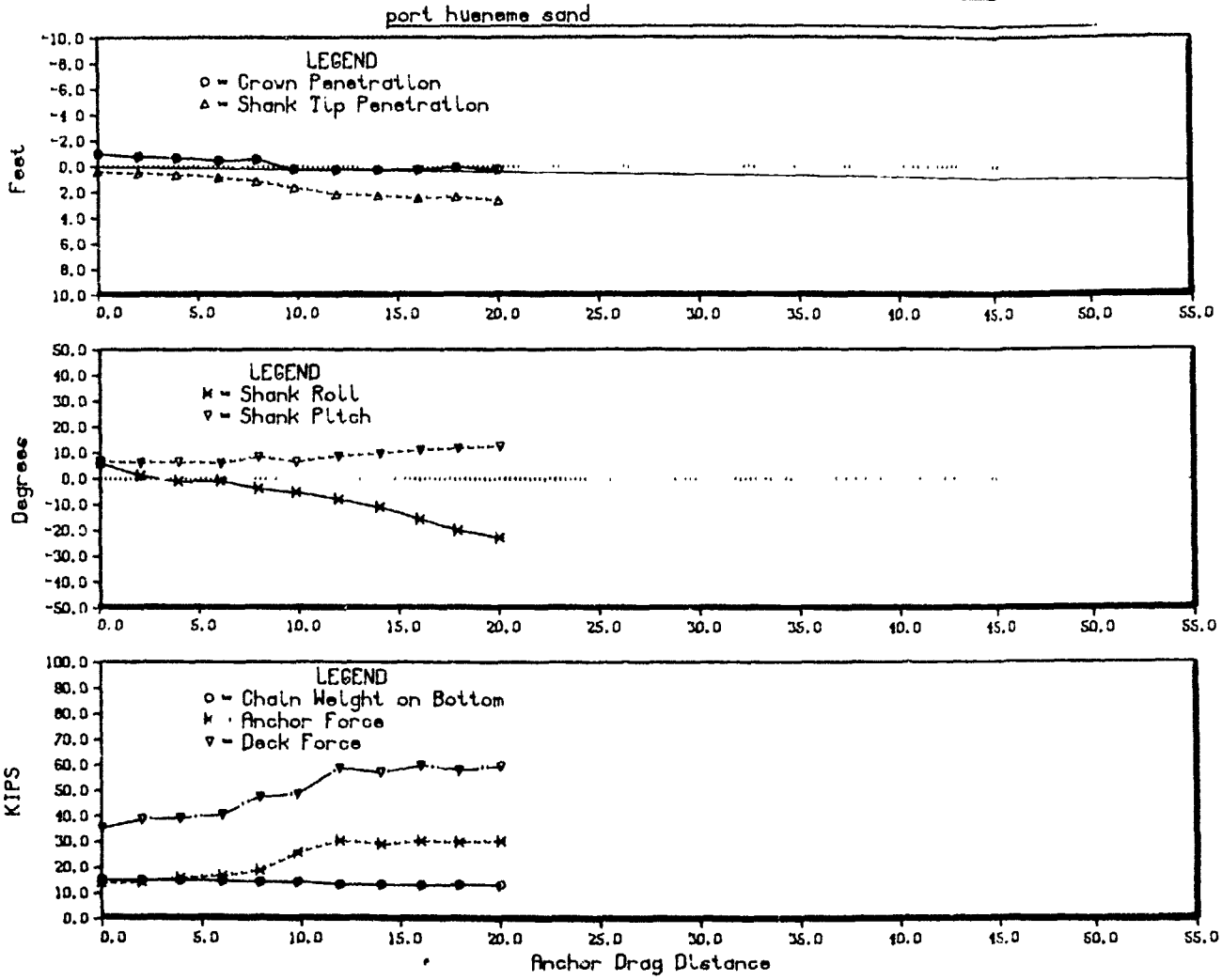
	10	11	12	13	14	15
	LBS	FEET	FEET	FEET	FEET	LBS
4	14437.1	40.0	41.4	43.6	41.0	17937.1
4	14435.4	40.4	41.8	44.0	41.0	17935.4
4	15046.4	40.7	42.1	44.3	41.0	18546.4
4	14701.9	37.9	40.0	41.7	41.0	18201.9
4	13185.2	40.6	42.5	44.3	41.0	16685.2
4	14127.7	40.7	42.9	44.5	41.0	17627.7
4	14510.6	37.8	40.2	41.5	41.0	18010.6
4	14875.2	37.8	40.1	41.4	41.0	18375.2
4	14264.2	40.3	42.7	43.9	41.0	17764.2
4	14288.4	39.2	41.7	42.8	41.0	17788.4
4	14472.3	39.4	42.0	43.0	41.0	17972.3

3

Day # - 304
Test No. - 8
Test Series No. - 0

WEST JETTY - PORT HUENEME

state 3500 lb, 32 degree movable flukes
port hueneme sand



STATO ANCHOR TEST

TEST DATE	304
TEST NO.	8
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1222 - 1232
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	STATO
ANCHOR WEIGHT	3500.00 LB.
FLUKE ANGLE-TYPE,	32.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN
	170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WI

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. ANCH
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. WATE
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. TOTA
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1	2	3	4	5	6	7	8	9	10	11
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET
0.0	35.8	14.0	40.7	6.0	7.0	6.4	35.5	289.3	15333.1	39.7
2.0	39.4	14.5	40.8	1.3	6.3	6.1	39.2	286.4	15145.9	39.9
3.9	39.7	16.0	40.9	-.8	6.5	5.8	39.5	288.9	15307.7	39.9
6.0	41.0	16.8	41.1	-.7	6.1	6.0	40.8	284.5	15019.3	40.2
7.9	47.9	19.0	41.3	-3.5	8.7	5.6	47.7	279.7	14697.9	40.1
9.8	49.1	26.0	41.9	-5.0	6.8	5.5	48.9	279.0	14647.3	40.9
11.9	59.4	30.7	42.2	-7.7	9.0	5.4	59.1	265.3	13740.5	40.9
14.0	57.8	29.4	42.3	-10.6	10.0	5.6	57.5	265.2	13731.4	40.9
16.0	60.4	30.7	42.4	-15.4	11.4	5.6	[illegible]	261.6	13493.8	40.9
17.9	58.7	30.2	42.3	-19.7	12.0	5.5	[illegible]	265.5	13750.0	40.7
20.0	60.2	30.6	42.5	-22.4	12.8	5.5	[illegible]	263.3	13607.2	40.8

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 20.0

2

ANCHOR TEST

PORT HUENEME

SAND

B.
0 0=MOV 1=FIX
IN CHAIN, 84 FT - 2.185 IN CHAIN
875 IN CHAIN, 34 FT - 2 IN WIRE ROPE

N LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
N WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
HOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
HOR SHANK TIP DEPTH CROWN

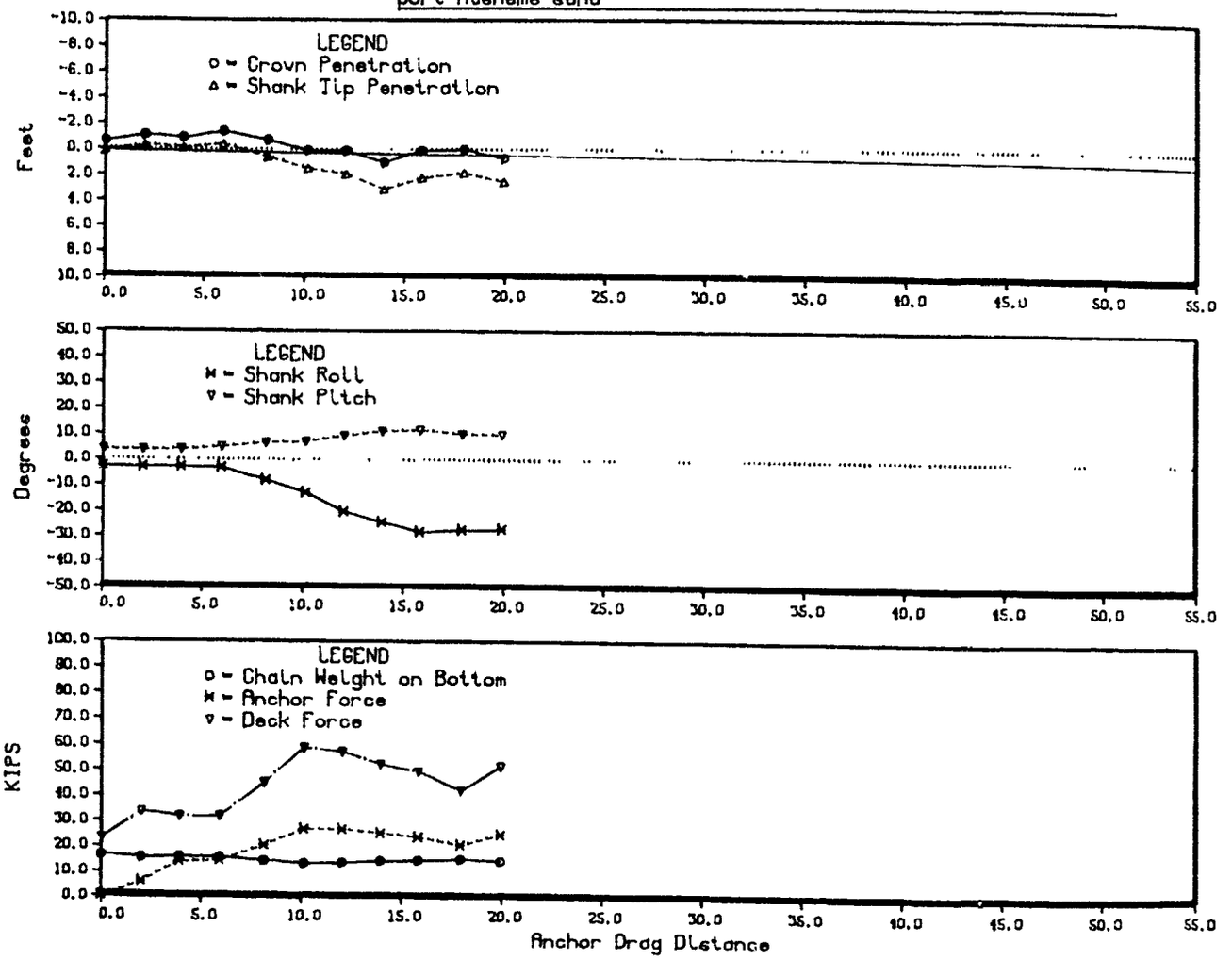
12	9	10	11	12	13	14	15
FEE	FEET	LBS	FEET	FEET	FEET	FEET	LBS
41.	289.3	15333.1	39.7	41.1	43.3	40.7	18833.1
41.	286.4	15145.9	39.9	41.2	43.4	40.7	18645.9
41.	288.9	15307.7	39.9	41.3	43.5	40.7	18807.7
41.	284.5	15019.3	40.2	41.4	43.8	40.7	18519.3
41.	279.7	14697.9	40.1	41.8	43.8	40.7	18197.9
42.	279.0	14647.3	40.9	42.3	44.5	40.7	18147.3
42.	265.3	13740.5	40.9	42.7	44.6	40.7	17240.5
42.	265.2	13731.4	40.9	42.9	44.7	40.7	17231.4
43.	261.6	13493.8	40.9	43.1	44.7	40.7	16993.8
43.	265.5	13750.0	40.7	43.0	44.5	40.7	17250.0
43.	263.3	13607.2	40.8	43.2	44.6	40.7	17107.2

3

Day # - 304
Test No. - 9
Test Series No. - 0

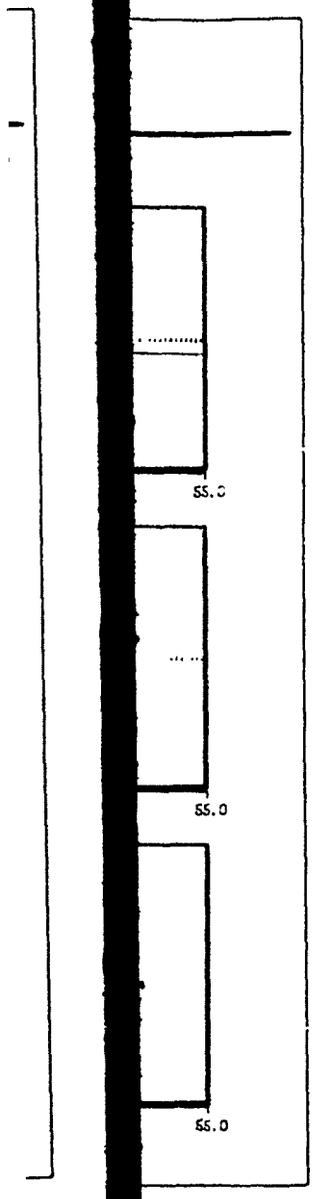
WEST JETTY - PORT HUENEME

state 3500 lb, 32 degree movable flukes
port hueneme sand



STATO ANCHOR TEST

TEST DATE	304
TEST NO.	9
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1917 - 1925
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	STATO
ANCHOR WEIGHT	3500.00 LB.
FLUKE ANGLE-TYPE,	32.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.
	170 FT - 2.875 IN CHAIN, 34 FT -



1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS
0.0	23.5	*****	35.1	-2.7	3.9	6.6	23.3	308.7	16623.7
2.0	33.8	6.0	34.6	-2.8	3.8	6.4	33.6	293.1	15589.7
3.9	31.9	14.0	34.8	-2.8	4.0	6.2	31.7	297.8	15900.9
5.9	32.1	14.4	34.5	-3.1	5.0	6.2	31.9	297.5	15883.7
8.1	45.3	20.5	35.4	-7.9	6.7	6.1	45.0	277.3	14537.8
10.1	59.0	27.0	36.2	-12.9	7.1	5.8	58.7	259.7	13366.2
12.0	57.4	27.0	36.5	-20.1	9.5	5.5	57.2	266.0	13787.2
13.9	52.6	25.5	37.6	-24.4	11.2	5.5	52.4	274.1	14326.6
15.8	49.9	24.0	36.7	-28.0	11.8	5.4	49.7	278.8	14636.4
17.9	42.4	21.0	36.4	-27.3	10.2	5.7	42.2	285.7	15094.3
19.9	52.0	25.0	37.1	-26.9	10.0	5.4	51.8	275.2	14397.9

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 19.9

2

ANCHOR TEST

RT HUENEME

ND

0=MOV 1=FIX
185
2 IN CHAIN, 84 FT - 2.185 IN CHAIN
IN CHAIN, 34 FT - 2 IN WIRE ROPE

3. A
4. W
5. T

ENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
EIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
SHANK TIP DEPTH CROWN

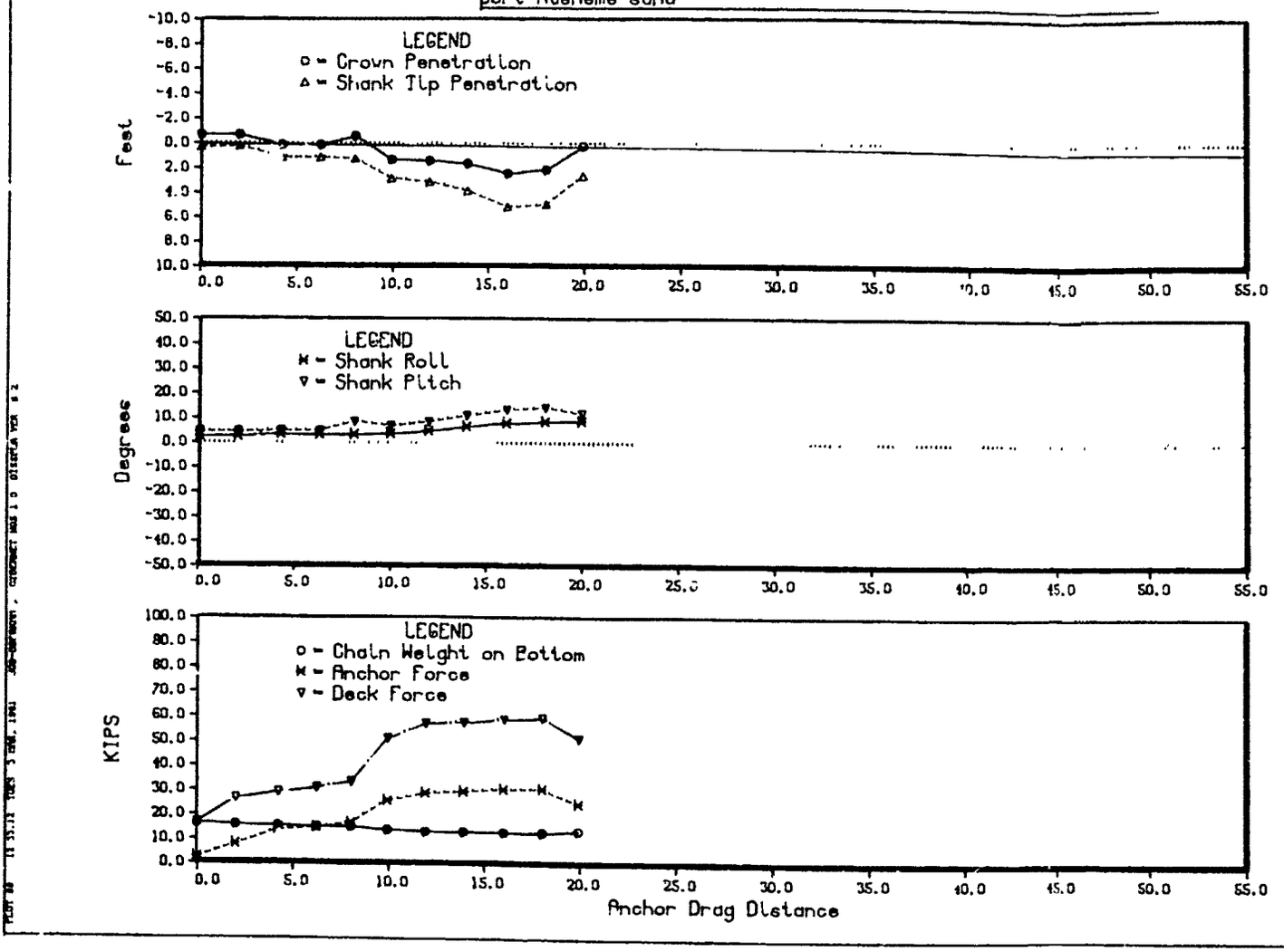
11 FEET	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
34.6	308.7	16623.7	34.6	35.4	37.9	35.1	20123.7
34.0	293.1	15589.7	34.0	34.8	37.4	35.1	19089.7
34.2	297.8	15900.9	34.2	35.0	37.6	35.1	19400.9
33.7	297.5	15883.7	33.7	34.8	37.2	35.1	19383.7
34.4	277.3	14537.8	34.4	35.7	38.0	35.1	18037.8
35.2	259.7	13366.2	35.2	36.6	38.7	35.1	16866.2
35.2	266.0	13787.2	35.2	37.0	38.8	35.1	17287.2
36.1	274.1	14326.6	36.1	38.2	39.7	35.1	17826.6
35.2	278.8	14636.4	35.2	37.3	38.7	35.1	18136.4
35.1	285.7	15094.3	35.1	37.0	38.6	35.1	18594.3
35.8	275.2	14397.9	35.8	37.6	39.2	35.1	17897.9

3

Day # - 304
Test No. - 10
Test Series No. - 0

WEST JETTY - PORT HUENEME

stato 3500 lb, 32 degree movable flukes
port hueneme sand



STATO ANCHOR TEST

TEST DATE	304
TEST NO.	10
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1619 - 1631
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	STATO
ANCHOR WEIGHT	3500.00 LB.
FLUKE ANGLE-TYPE,	32.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN 170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WI

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCH
14. WATE
15. TOTA

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	17.2	2.5	41.9	2.6	4.6	9.3	17.0	307.4	16542.4	41.3
2.0	26.9	8.0	41.9	2.8	4.6	7.2	26.7	298.9	15974.3	41.2
4.2	29.5	14.0	42.8	3.6	5.0	7.3	29.3	293.0	15579.6	42.1
6.2	31.5	15.0	42.8	3.6	5.0	7.2	31.2	290.2	15394.3	42.1
8.0	33.7	17.0	42.6	3.5	8.7	6.7	33.5	290.2	15395.3	41.3
9.9	51.4	26.0	44.3	3.8	7.0	5.9	51.1	269.5	14021.3	43.3
11.9	57.5	29.0	44.5	5.0	8.6	5.9	57.2	260.5	13417.9	43.3
13.9	58.1	29.7	45.1	6.7	11.1	5.8	57.8	260.9	13449.1	43.5
16.0	59.4	30.7	46.3	8.3	13.5	5.9	59.1	257.3	13204.1	44.4
18.0	60.1	30.8	46.1	8.8	14.4	5.9	59.7	256.2	13136.0	44.0
19.9	51.7	25.0	43.9	9.0	12.1	6.0	51.4	268.3	13935.4	42.2

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 19.9

2

ANCHOR TEST

HUENEME

0=MOV 1=FIX
CHAIN HAIN, 84 FT - 2.185 IN CHAIN
RE RO CHAIN, 34 FT - 2 IN WIRE ROPE

OR FL GTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
R DEP GHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
L BOT OWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
ANK TIP DEPTH CROWN

12		10	11	12	13	14	15
FEET	ET	LBS	FEET	FEET	FEET	FEET	LBS
42.2	7.4	16542.4	41.3	42.2	44.7	41.9	20042.4
42.1	8.9	15974.3	41.2	42.1	44.6	41.9	19474.3
43.1	3.0	15579.6	42.1	43.1	45.5	41.9	19079.6
43.1	0.2	15394.3	42.1	43.1	45.5	41.9	18894.3
43.1	0.2	15395.3	41.3	43.1	45.1	41.9	18895.3
44.7	9.5	14021.3	43.3	44.7	46.9	41.9	17521.3
45.0	0.5	13417.9	43.3	45.0	47.0	41.9	16917.9
45.8	0.9	13449.1	43.5	45.8	47.4	41.9	16949.1
47.1	7.3	13204.1	44.4	47.1	48.4	41.9	16704.1
46.9	6.2	13136.0	44.0	46.9	48.1	41.9	16636.0
44.6	8.3	13935.4	42.2	44.6	46.1	41.9	17435.4

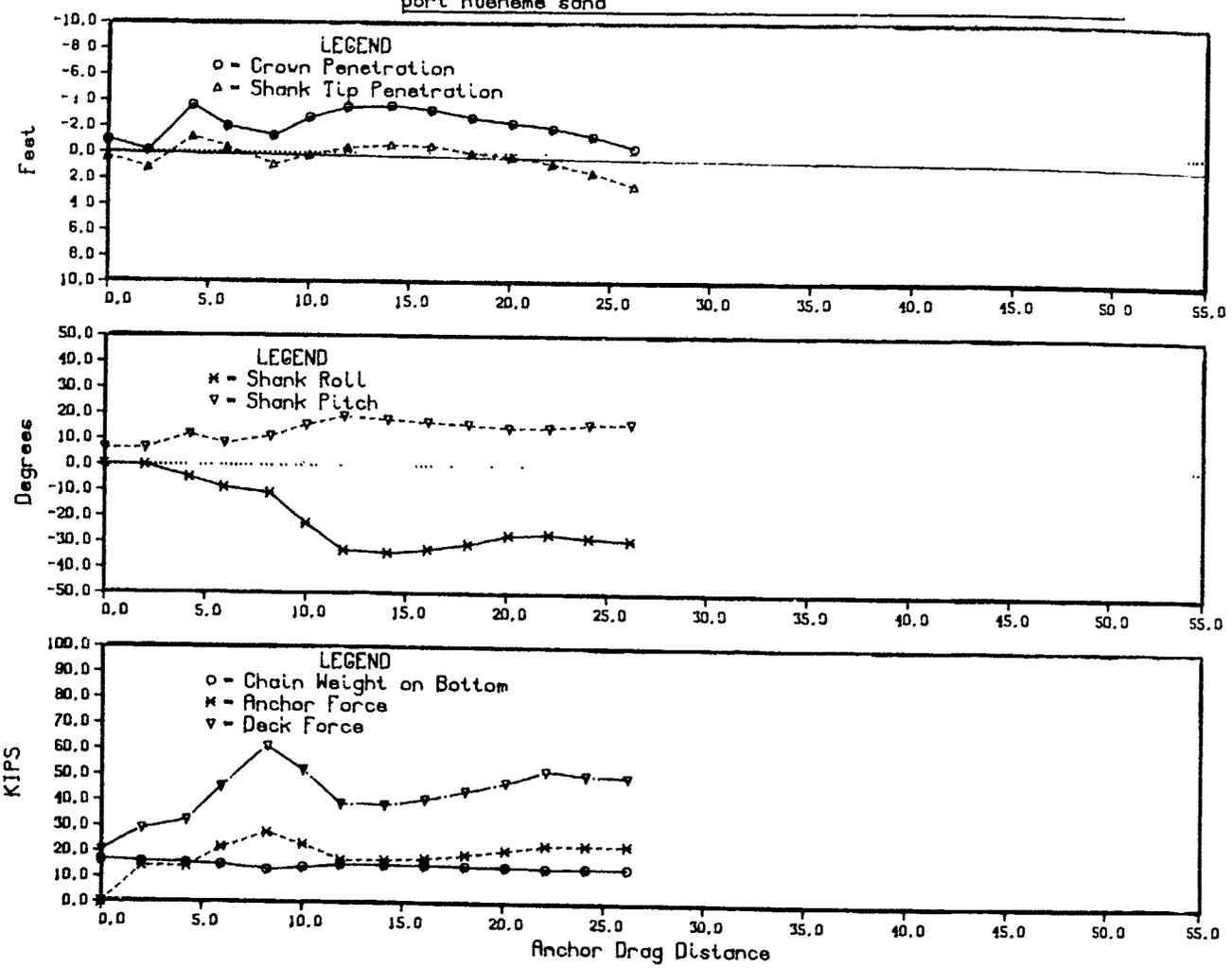
3

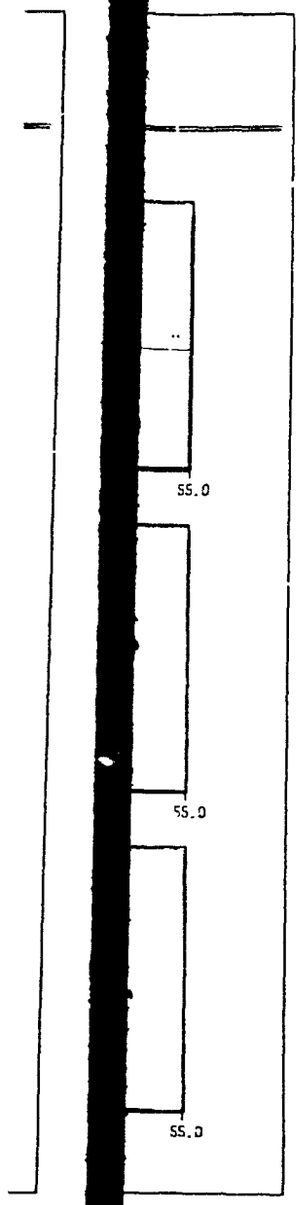
Day # - 304
Test No. - 11
Test Series No. - 0

WEST JETTY - PORT HUENEME

stato 3500 lb, 32 degree movable flukes

port hueneme sand





STATO ANCHOR TEST

TEST DATE	304
TEST NO.	11
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1639 - 1651
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	STATO
ANCHOR WEIGHT	3500.00 LB.
FLUKE ANGLE-TYPE,	32.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.1
	170 FT - 2.875 IN CHAIN, 34 FT - 2

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13
14
15

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	F
0.0	20.5	*****	42.9	.2	6.3	7.3	20.4	310.1	16720.7	4
2.0	29.2	14.3	43.7	-.2	6.4	6.7	29.0	298.5	15947.5	4
4.2	32.5	14.0	41.0	-5.0	11.8	6.8	32.3	291.3	15470.0	3
5.9	45.6	21.6	42.1	-8.9	8.4	5.8	45.3	280.7	14766.0	4
8.2	61.3	27.6	43.2	-11.0	11.1	5.9	61.0	254.8	13039.0	4
10.0	52.4	23.0	42.3	-22.8	15.7	5.9	52.1	269.1	13994.8	4
11.9	39.3	17.0	41.6	-33.0	19.0	6.0	39.1	287.9	15239.9	3
14.1	39.0	17.0	41.5	-34.0	17.8	6.4	38.7	284.1	14987.7	3
16.1	41.1	17.6	41.7	-32.8	16.8	6.2	40.8	282.2	14866.5	3
18.1	44.3	19.0	42.2	-30.7	15.9	6.2	44.0	277.1	14526.4	4
20.1	47.6	21.0	42.5	-27.1	14.7	6.1	47.4	273.6	14292.9	4
22.1	52.2	23.0	43.0	-26.6	14.9	5.9	52.0	268.1	13924.4	4
24.1	50.7	23.0	43.6	-28.1	16.1	5.9	50.4	270.8	14104.5	4
26.2	50.0	23.0	44.6	-28.9	16.5	6.1	49.7	269.0	13985.9	4

DISTANCE BARGE TRAVELLED 26.0
DISTANCE ANCHOR TRAVELLED 26.2

2

ANCHOR TEST

RT HUENEME

ND

0=MOV 1=FIX
CHAIN, 84 FT - 2.185 IN CHAIN
IN CHAIN, 34 FT - 2 IN WIRE ROPE

ENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
EIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
SHANK TIP DEPTH CROWN

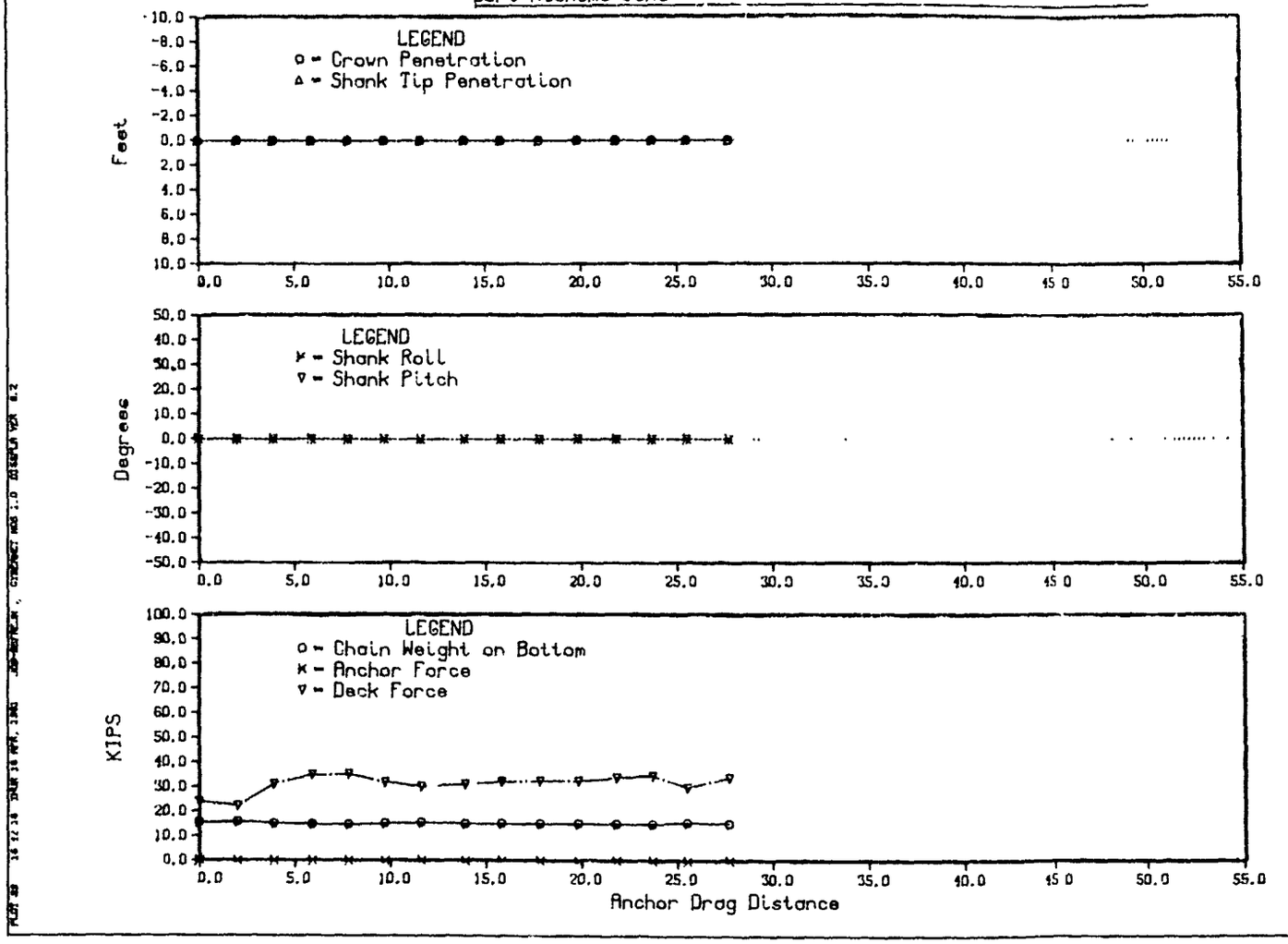
9	10	11	12	13	14	15
FEET	LBS	FEET	FEET	FEET	FEET	LBS
310.1	16720.7	42.0	43.3	45.6	42.9	20220.7
298.5	15947.5	42.8	44.1	46.4	42.9	19447.5
291.3	15470.0	39.3	41.7	43.3	42.9	18970.0
280.7	14766.0	40.9	42.6	44.6	42.9	18266.0
254.8	13039.0	41.6	43.8	45.5	42.9	16539.0
269.1	13994.8	40.2	43.1	44.1	42.9	17494.8
287.9	15239.9	39.4	42.5	43.1	42.9	18739.9
284.1	14987.7	39.4	42.3	43.0	42.9	18487.7
282.2	14866.5	39.6	42.5	43.3	42.9	18366.5
277.1	14526.4	40.2	42.9	43.9	42.9	18026.4
273.6	14292.9	40.6	43.3	44.4	42.9	17792.9
268.1	13924.4	41.0	43.7	44.8	42.9	17424.4
270.8	14104.5	41.6	44.4	45.4	42.9	17604.5
269.0	13985.9	42.5	45.4	46.3	42.9	17485.9

3

Day # = 305
Test No. = 12
Test Series No. = 0

WEST JETTY - PORT HUENEME

bruce twin-shank 1100 lb. fixed flukes
port hueneme sand



BRUCE ANCHOR TEST

TEST DATE	305
TEST NO.	12
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	812 - 824
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	BRUCE
ANCHOR WEIGHT	1100.00 LB.
FLUKE ANGLE-TYPE,	***** DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN 170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WI

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCH
14. WATE
15. TOTA

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	24.1	*****	*****	*****	*****	*****	*****	294.1	15654.1	*****
2.0	22.4	*****	*****	*****	*****	*****	*****	299.9	16041.4	*****
3.9	31.4	*****	*****	*****	*****	*****	*****	286.9	15173.7	*****
5.9	35.1	*****	*****	*****	*****	*****	*****	282.2	14865.8	*****
7.8	35.4	*****	*****	*****	*****	*****	*****	282.2	14863.3	*****
9.7	32.3	*****	*****	*****	*****	*****	*****	288.8	15301.6	*****
11.6	30.4	*****	*****	*****	*****	*****	*****	292.3	15537.5	*****
13.9	31.5	*****	*****	*****	*****	*****	*****	287.3	15202.8	*****
15.8	32.5	*****	*****	*****	*****	*****	*****	287.0	15180.3	*****
17.8	32.9	*****	*****	*****	*****	*****	*****	286.3	15138.2	*****
19.8	32.8	*****	*****	*****	*****	*****	*****	286.7	15164.1	*****
21.8	34.2	*****	*****	*****	*****	*****	*****	284.1	14990.9	*****
23.7	34.1	*****	*****	*****	*****	*****	*****	285.2	15060.4	*****
25.5	30.2	*****	*****	*****	*****	*****	*****	294.9	15710.5	*****
27.7	34.2	*****	*****	*****	*****	*****	*****	286.6	15157.9	*****

DISTANCE BARGE TRAVELLED 28.0
DISTANCE ANCHOR TRAVELLED 27.7

2

ANCHOR TEST

RT HUENEME

ND

0=MOV 1=FIX
CHAIN, 84 FT - 2.185 IN CHAIN
IN CHAIN, 34 FT - 2 IN WIRE ROPE

ENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
EIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
SHANK TIP DEPTH CROWN

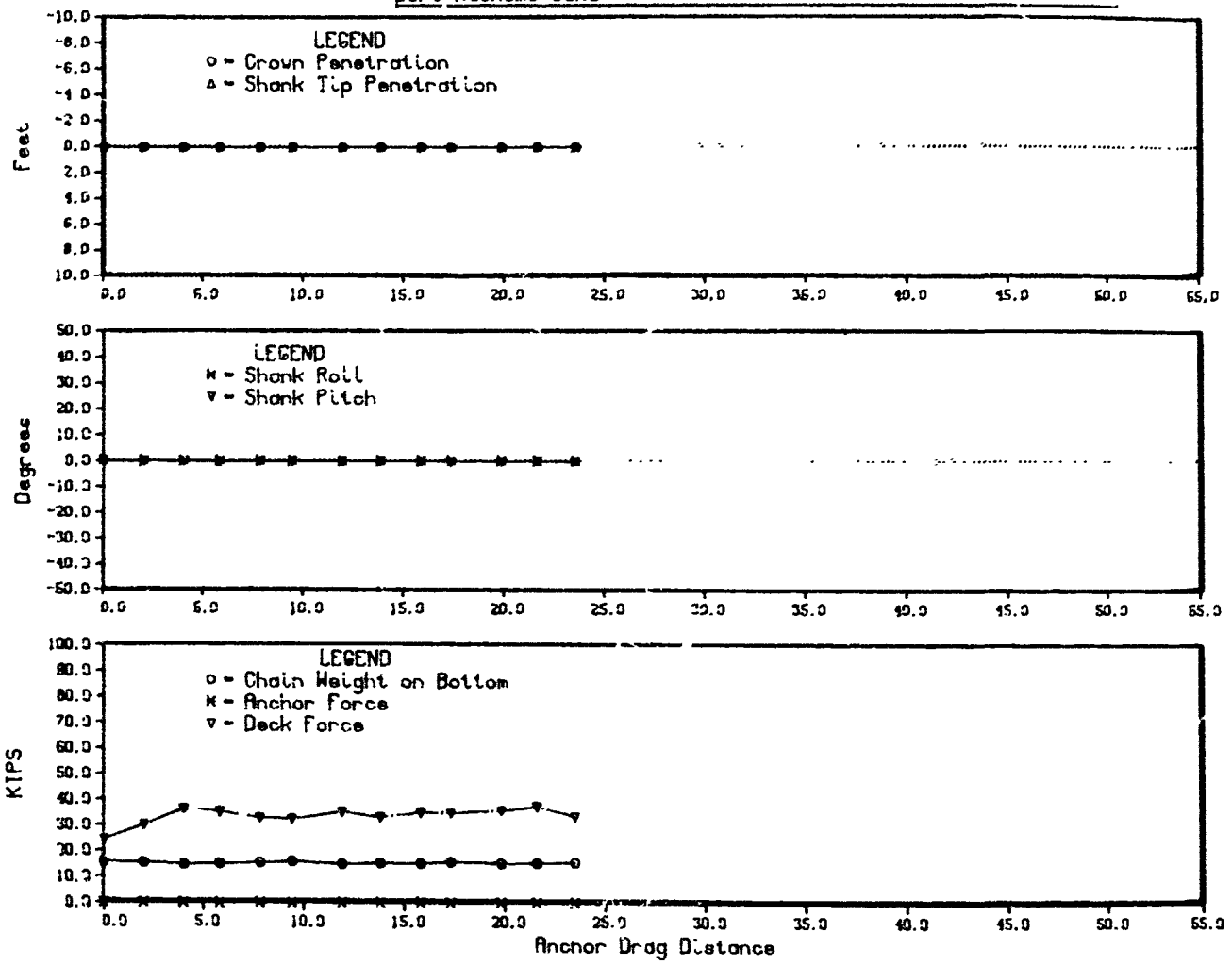
9	10	11	12	13	14	15
FEET	LBS	FEET	FEET	FEET	FEET	LBS
294.1	15654.1	*****	*****	*****	*****	16754.1
299.9	16041.4	*****	*****	*****	*****	17141.4
286.9	15173.7	*****	*****	*****	*****	16273.7
282.2	14865.8	*****	*****	*****	*****	15965.8
282.2	14863.3	*****	*****	*****	*****	15963.3
288.8	15301.6	*****	*****	*****	*****	16401.6
292.3	15537.5	*****	*****	*****	*****	16637.5
287.3	15202.8	*****	*****	*****	*****	16302.8
287.0	15180.3	*****	*****	*****	*****	16280.3
286.3	15138.2	*****	*****	*****	*****	16238.2
286.7	15164.1	*****	*****	*****	*****	16264.1
284.1	14990.9	*****	*****	*****	*****	16090.9
285.2	15060.4	*****	*****	*****	*****	16160.4
294.9	15710.5	*****	*****	*****	*****	16810.5
286.6	15157.9	*****	*****	*****	*****	16257.9

3

Day # - 305
Test No. - 13
Test Series No. - 0

WEST JETTY - PORT HUENEME

bruce twin-shank 1100 lb, fixed flukes
port hueneme sand



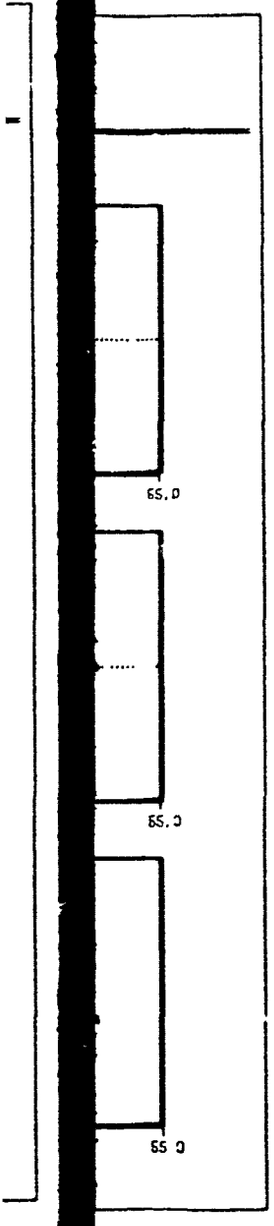
BRUCE ANCHOR TEST

TEST DATE	305
TEST NO.	13
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	836 - 850
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	BRUCE
ANCHOR WEIGHT	1100.00 LB.
FLUKE ANGLE-TYPE,	***** DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 64 FT - 2.18
	170 FT - 2.875 IN CHAIN, 34 FT - 2

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	F
0.0	24.5	*****	*****	*****	*****	*****	*****	295.4	15741.8	**
2.0	30.1	*****	*****	*****	*****	*****	*****	291.1	15453.8	**
4.0	36.3	*****	*****	*****	*****	*****	*****	282.9	14908.1	**
5.8	35.5	*****	*****	*****	*****	*****	*****	286.0	15117.3	**
7.8	32.9	*****	*****	*****	*****	*****	*****	290.6	15422.5	**
9.4	32.5	*****	*****	*****	*****	*****	*****	298.1	15924.2	**
11.9	35.4	*****	*****	*****	*****	*****	*****	284.8	15037.2	**
13.8	33.3	*****	*****	*****	*****	*****	*****	289.2	15330.2	**
15.8	35.2	*****	*****	*****	*****	*****	*****	286.7	15161.4	**
17.3	34.7	*****	*****	*****	*****	*****	*****	296.9	15839.0	**
19.8	35.8	*****	*****	*****	*****	*****	*****	286.6	15155.3	**
21.6	37.4	*****	*****	*****	*****	*****	*****	288.0	15288.1	**
23.5	33.6	*****	*****	*****	*****	*****	*****	294.1	15656.2	**

DISTANCE BARGE TRAVELLED 24.0
DISTANCE ANCHOR TRAVELLED 23 5



ANCHOR TEST

RT HUENEME

ND

0=MOV 1=FIX
CHAIN, 64 FT - 2.185 IN CHAIN
IN CHAIN, 34 FT - 2 IN WIRE ROPE

ENGTH ON BOTTOM
EIGHT ON BOTTOM
CROWN DEPTH
SHANK TIP DEPTH

13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
295.4	15741.8	*****	*****	*****	*****	16841.8
291.1	15453.8	*****	*****	*****	*****	16553.8
282.9	14908.1	*****	*****	*****	*****	16008.1
286.0	15117.3	*****	*****	*****	*****	16217.3
290.6	15422.5	*****	*****	*****	*****	16522.5
298.1	15924.2	*****	*****	*****	*****	17024.2
284.8	15037.2	*****	*****	*****	*****	16137.2
289.2	15330.2	*****	*****	*****	*****	16430.2
286.7	15161.4	*****	*****	*****	*****	16261.4
296.9	15839.0	*****	*****	*****	*****	16939.0
286.6	15155.3	*****	*****	*****	*****	16255.3
288.6	15288.1	*****	*****	*****	*****	16388.1
294.1	15656.2	*****	*****	*****	*****	16756.2

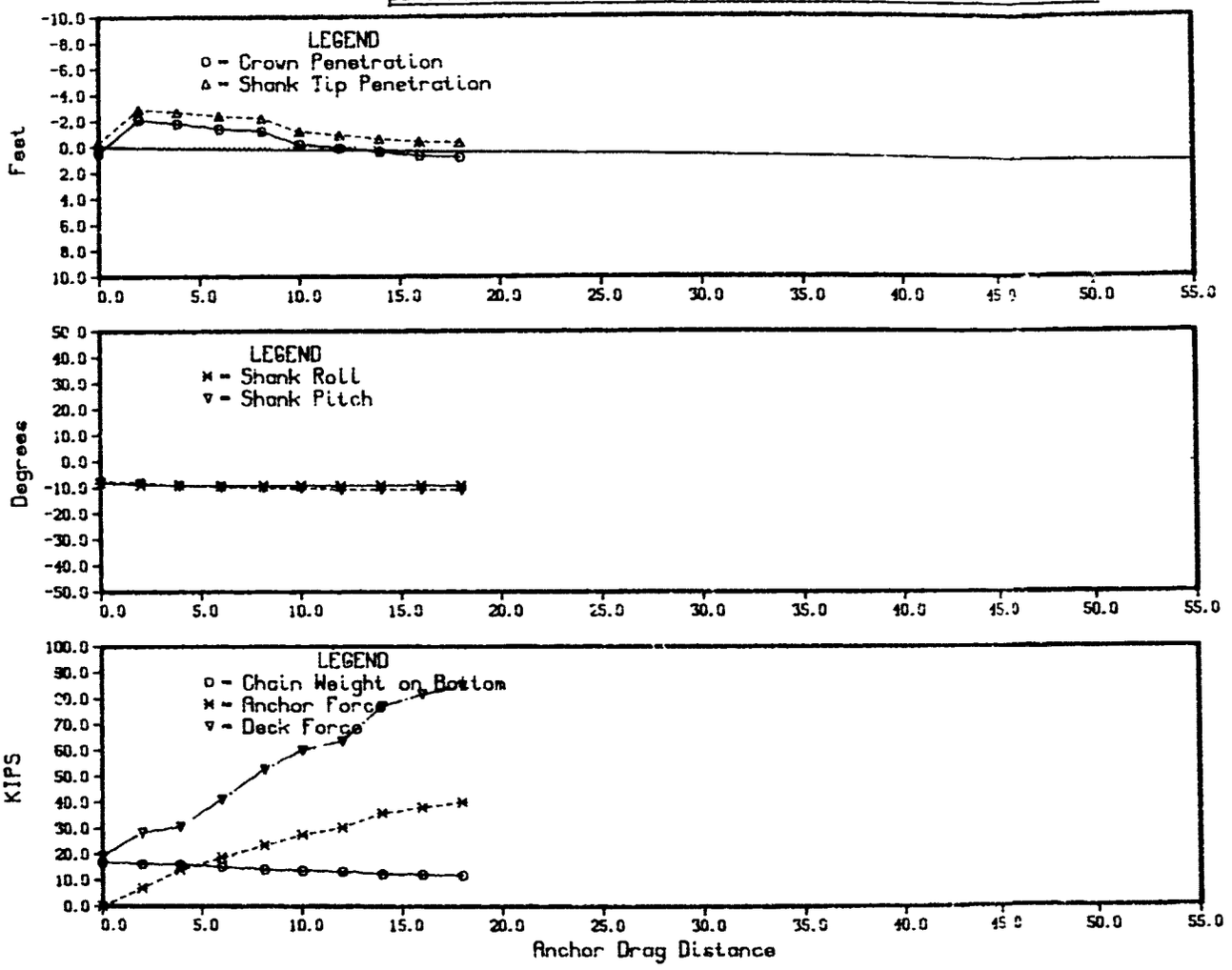
3

Day # - 305
Test No. - 14
Test Series No. - 0

WEST JETTY - PORT HUENEME

two fluke balanced w/o ball guide 8000 lb, 40 deg mov flukes

port hueneme sand



TWO FLUKE ANCHOR TEST

TEST DATE	305
TEST NO.	14
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1058 - 1112
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	TWO FLUKE
ANCHOR WEIGHT	8000.00 LB.
FLUKE ANGLE-TYPE,	45.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT - 2.185 IN 170 FT - 2.875 IN CHAIN, 34 FT - 2 IN WI

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCH
14. WATE
15. TOTA

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	19.3	*****	46.5	-8.3	-7.8	7.7	19.1	310.4	16738.6	46.9
2.0	28.6	7.0	43.8	-8.9	-8.2	6.5	28.4	300.9	16106.3	44.3
3.9	30.8	14.0	44.1	-9.1	-9.2	6.2	30.6	299.3	15998.9	44.7
6.0	41.4	18.7	44.4	-9.3	-9.8	6.0	41.1	284.9	15043.2	45.0
8.1	52.9	23.4	44.6	-9.4	-10.1	5.8	52.7	269.1	13989.8	45.3
10.0	60.3	27.5	45.7	-9.2	-10.1	5.4	60.1	263.4	13610.1	46.3
12.0	64.0	30.4	45.9	-9.3	-10.7	5.4	63.7	258.4	13278.1	46.6
14.0	77.3	35.8	46.2	-9.2	-10.8	5.2	77.0	243.9	12314.0	46.9
16.0	81.9	38.0	46.5	-9.2	-10.8	5.1	81.6	240.6	12093.7	47.1
18.0	85.2	40.0	46.6	-9.4	-10.9	5.1	84.9	236.2	11801.2	47.3

DISTANCE BARGE TRAVELLED 18.0
DISTANCE ANCHOR TRAVELLED 18.0

2

CHOR TEST

UENEME

=MOV 1=FIX
IN, 84 FT - 2.185 IN CHAIN
HAIN, 34 FT - 2 IN WIRE ROPE

H ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
T ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
N DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
K TIP DEPTH CROWN

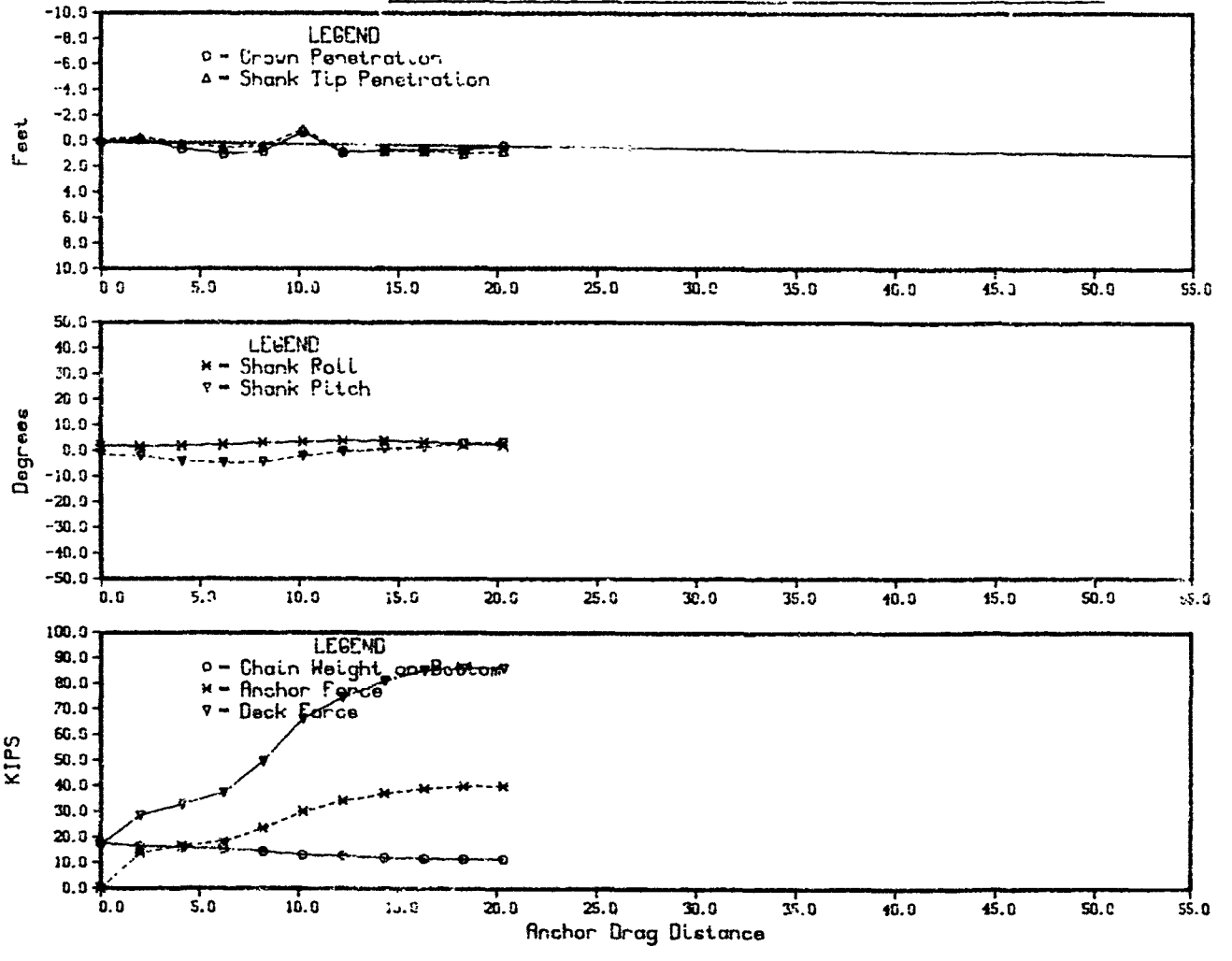
	10	11	12	13	14	15
	LBS	FEET	FEET	FEET	FEET	LBS
4	16738.6	46.9	46.2	49.6	46.5	24738.6
9	16106.3	44.3	43.5	46.9	46.5	24106.3
3	15998.9	44.7	43.7	47.2	46.5	23998.9
9	15043.2	45.0	44.1	47.6	46.5	23043.2
1	13989.8	45.3	44.2	47.8	46.5	21989.8
4	13610.1	46.3	45.3	48.8	46.5	21610.1
4	13278.1	46.6	45.5	49.1	46.5	21278.1
9	12314.0	46.9	45.8	49.4	46.5	20314.0
6	12093.7	47.1	46.1	49.6	46.5	20093.7
2	11801.2	47.3	46.2	49.7	46.5	19801.2

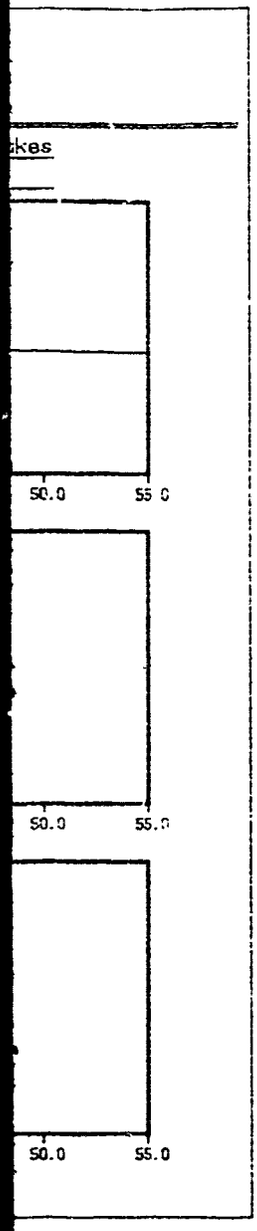
3

Day # - 305
Test No. - 15
Test Series No. - 0

WEST JETTY -- PORT HUENEME

two fluke balanced w/o ball guide 8000 lb, 40 deg mov flukes
port hueneme sand





TWO FLUKE ANCHOR TEST

TEST DATE	305
TEST NO.	15
TEST RUN	0
TEST AREA	WEST JETTY - PORT HUENEME
START-END TIMES	1123 - 1134
SEAFLOOR TYPE	PORT HUENEME SAND
ANCHOR TYPE	TWO FLUKE
ANCHOR WEIGHT	8000.00 LB.
FLUKE ANGLE-TYPE,	45.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	62 FT - 2.25 IN CHAIN, 84 FT -
	170 FT - 2.875 IN CHAIN, 34 FT

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH

1	2	3	4	5	6	7	8	9	10
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS
0.0	16.9	*****	45.8	1.9	-1.6	6.2	16.8	376.1	17498.0
2.0	28.6	13.8	45.6	1.6	-2.1	6.0	28.5	304.7	16358.8
4.1	33.0	16.5	46.2	2.0	-4.1	6.1	32.8	297.0	15847.8
6.2	37.5	18.2	46.5	2.4	-4.7	6.0	37.3	290.3	15405.3
8.2	49.9	23.5	46.4	3.2	-4.4	5.6	49.7	276.4	14474.6
10.2	66.4	30.0	45.0	3.4	-2.2	5.4	66.1	256.2	13130.7
12.2	74.9	34.0	46.7	3.9	-.4	5.1	74.6	248.7	12635.1
14.3	81.4	37.0	46.6	3.9	.8	5.2	81.1	238.9	11981.4
16.3	85.6	38.8	46.6	3.3	1.3	5.2	85.2	233.4	11617.9
18.3	86.4	39.3	46.7	2.4	2.8	5.2	86.0	231.9	11517.6
20.3	86.3	40.0	46.5	2.2	3.3	5.2	86.0	232.9	11584.0

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 20.3

2

TWO FLUKE ANCHOR TEST

JETTY - PORT HUENEME
- 1134
HUENEME SAND
LUKE
0.00 LB.
DEG. - 0 0=MOV 1=FIX
- 2.25 IN CHAIN, 84 FT - 2.185 IN CHAIN
T - 2.875 IN CHAIN, 34 FT - 2 IN WIRE ROPE

9. CHAIN LENGTH ON BOTTOM
0. CHAIN WEIGHT ON BOTTOM
1. ANCHOR CROWN DEPTH
2. ANCHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
16.8	376.1	17498.0	45.9	45.8	49.0	45.8	25498.0
28.5	304.7	16358.8	45.7	45.5	48.7	45.8	24358.8
32.8	297.0	15847.8	46.5	46.0	49.3	45.8	23847.8
37.3	290.3	15405.3	46.8	46.3	49.7	45.8	23405.3
49.7	276.4	14474.6	46.7	46.2	49.5	45.8	22474.6
66.1	256.2	13130.7	45.1	44.9	48.1	45.8	21130.7
74.6	248.7	12635.1	46.7	46.7	49.8	45.8	20635.1
81.1	238.9	11981.4	46.5	46.6	49.7	45.8	19981.4
85.2	233.4	11617.9	46.5	46.7	49.7	45.8	19617.9
86.0	231.9	11517.6	46.5	46.8	49.8	45.8	19517.6
86.0	232.9	11584.0	46.3	46.6	49.6	45.8	19584.0

3

Appendix C

DATA FOR INDIAN ISLAND TESTS

Appendix C

DATA FOR INDIAN ISLAND TESTS

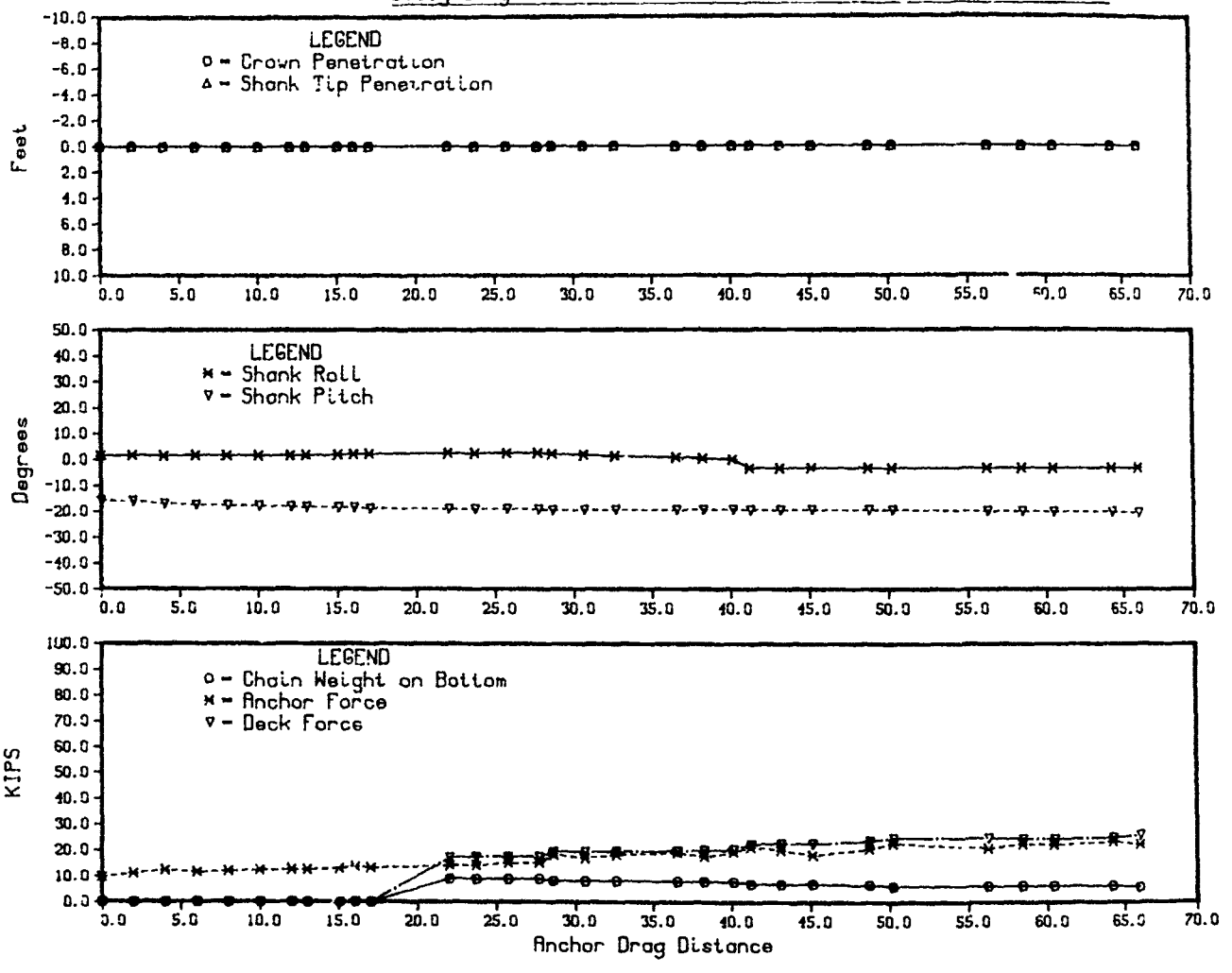
All the data for the anchor tests conducted at Indian Island in mud are included in this appendix. Refer to the introduction of Appendix B for a general description of the data plots and tabularized listings.

Problems occurred with the depth measurement. Good depth data was recovered in only two (tests 5 and 12) out of ten tests. The instrument package was not used for two of the tests presented. The pressure tranducer line was continually becoming kinked or blocked with mud. Final anchor depth was recorded for one other test (test 2) after the pressure hose apparently become unkinked.

Dcy # - 207
Test No. - 1
Test Series No. - 0

INDIAN ISLAND

two fluke balanced w/o ballguide
silty clay



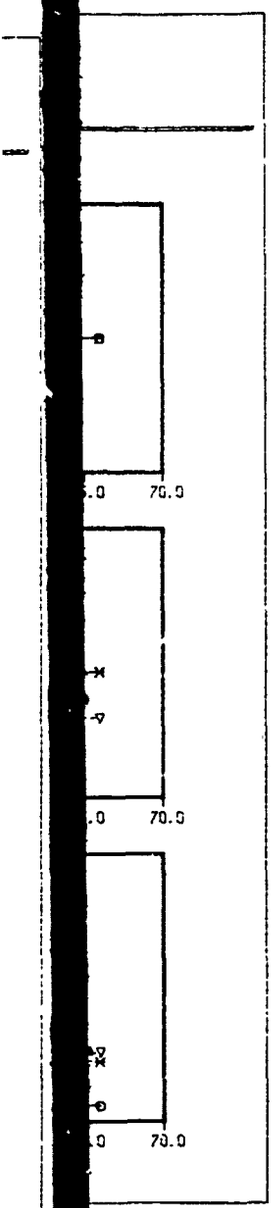
TWO FLUKE ANCHOR TEST

TEST DATE	207
TEST NO.	1
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1616 - 1646
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	TWO FLUKE BALANCED W/O BALLGUID
ANCHOR WEIGHT	8000.00 LB.
FLUKE ANGLE-TYPE	40.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT -

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS
0.0	*****	9.5	*****	1.4	-15.9	*****	*****	******	*******
2.0	*****	11.2	*****	1.5	-16.0	*****	*****	******	*******
4.0	*****	12.4	*****	1.4	-17.0	*****	*****	******	*******
6.0	*****	11.5	*****	1.5	-17.5	*****	*****	******	*******
8.0	*****	12.0	*****	1.5	-17.6	*****	*****	******	*******
10.0	*****	12.4	*****	1.5	-17.7	*****	*****	******	*******
12.0	*****	12.5	*****	1.5	-18.1	*****	*****	******	*******
13.0	*****	12.6	*****	1.7	-18.3	*****	*****	******	*******
15.0	*****	13.1	*****	1.5	-18.4	*****	*****	******	*******
16.0	*****	13.7	*****	2.0	-18.6	*****	*****	******	*******
17.0	*****	13.3	*****	2.2	-18.8	*****	*****	******	*******
22.0	23.5	14.1	*****	2.4	-19.0	43.1	17.2	226.9	9134.1
23.7	23.5	14.2	*****	2.4	-19.0	42.8	17.5	225.5	9035.4
25.7	23.5	15.1	*****	2.5	-19.0	42.8	17.5	225.4	9032.3
27.7	23.5	15.2	*****	2.5	-19.2	42.8	17.5	225.4	9032.3
28.6	25.7	16.2	*****	2.1	-19.5	41.1	19.4	215.5	8315.6
30.6	25.5	17.0	*****	1.8	-19.4	41.0	19.5	214.8	8266.9
32.5	25.5	16.2	*****	1.3	-19.4	41.0	19.5	214.9	8270.3
36.5	26.1	19.0	*****	.9	-19.4	40.8	19.8	213.1	8145.7
38.2	26.3	17.5	*****	.5	-19.3	40.6	20.0	212.5	8102.1
40.1	26.7	19.3	*****	.1	-19.3	40.3	20.4	210.1	7930.7
41.2	28.7	21.2	*****	-3.3	-19.4	38.8	22.4	200.1	7208.7
43.1	29.0	20.1	*****	-3.3	-19.4	38.6	22.7	196.7	7107.5
45.1	28.4	18.2	*****	-3.3	-19.4	38.7	22.6	199.1	7134.4
48.7	29.9	20.5	*****	-3.3	-19.4	38.0	23.6	194.4	6795.8
50.2	31.1	22.6	*****	-3.3	-19.4	37.2	24.8	188.7	6388.3
56.2	31.1	20.3	*****	-3.3	-19.9	37.2	24.8	188.8	6397.0
58.4	30.7	22.4	*****	-3.3	-19.9	37.5	24.4	190.5	6519.5
60.4	30.7	22.1	*****	-3.3	-20.1	37.5	24.4	190.6	6523.8
64.2	31.1	23.2	*****	-3.3	-20.2	37.2	24.8	188.8	6392.6
66.0	32.2	22.1	*****	-3.3	-20.5	36.7	25.8	182.9	5965.5

DISTANCE VESSEL TRAVELLED 70.0
DISTANCE ANCHOR TRAVELLED 66.0



ANCHOR TEST

ANCED W/O BALLGUIDE

) 0=MOV 1=FIX
IN CHAIN, 270 FT - 3.0 IN CHAIN

LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
SHANK TIP DEPTH CROWN

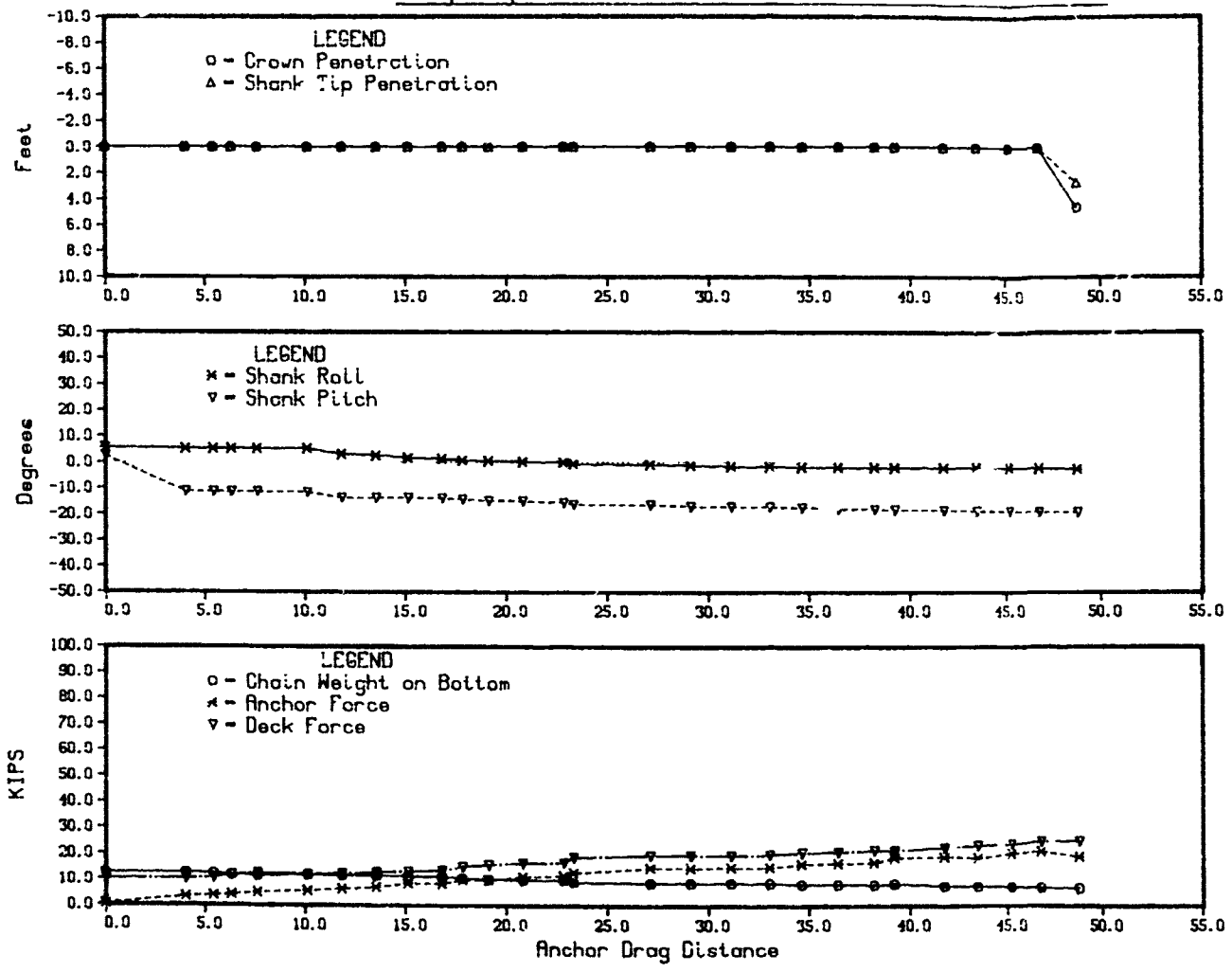
9	10	11	12	13	14	15
FEET	LBS	FEET	FEET	FEET	FEET	LBS
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
******	*******	*****	*****	*****	88.0	*******
226.9	9134.1	*****	*****	*****	88.0	17134.1
225.5	9035.4	*****	*****	*****	88.0	17035.4
225.4	9032.3	*****	*****	*****	88.0	17032.3
225.4	9032.3	*****	*****	*****	88.0	17032.3
215.5	8315.6	*****	*****	*****	88.0	16315.6
214.8	8266.9	*****	*****	*****	88.0	16266.9
214.9	8270.3	*****	*****	*****	88.0	16270.3
213.1	8145.7	*****	*****	*****	88.0	16145.7
212.5	8102.1	*****	*****	*****	88.0	16102.1
210.1	7930.7	*****	*****	*****	88.0	15930.7
200.1	7208.7	*****	*****	*****	88.0	15208.7
196.7	7107.5	*****	*****	*****	88.0	15107.5
199.1	7134.4	*****	*****	*****	88.0	15134.4
194.4	6795.8	*****	*****	*****	88.0	14795.8
188.7	6388.3	*****	*****	*****	88.0	14388.3
188.8	6397.0	*****	*****	*****	88.0	14397.0
190.5	6519.5	*****	*****	*****	88.0	14519.5
190.6	6523.8	*****	*****	*****	88.0	14523.8
188.8	6392.6	*****	*****	*****	88.0	14392.6
182.9	5965.5	*****	*****	*****	88.0	13965.5

Day # - 208
Test No. - 2
Test Series No. - 0

INDIAN ISLAND

two fluke balanced w/o ballguide

silty clay



TWO FLUKE ANCHOR TEST

TEST DATE	208
TEST NO.	2
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1002 - 1025
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	TWO FLUKE BALANCED W/O BALLGUIDE
ANCHOR WEIGHT	8000.00 LB.
FLUKE ANGLE-TYPE,	40.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0 IN C

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCI
14. WATI
15. TOT

1	2	3	4	5	6	7	8	9	10	11
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET
0.0	16.2	.2	*****	5.6	2.5	51.0	10.2	275.1	12610.2	*****
4.0	15.3	2.4	*****	5.2	-11.3	50.9	10.3	274.3	12550.4	*****
5.4	16.6	4.9	*****	5.2	-11.3	50.1	10.7	271.5	12350.0	*****
6.3	17.4	6.2	*****	5.2	-11.4	49.5	11.8	264.8	11866.6	*****
7.6	18.5	5.0	*****	5.2	-11.4	47.5	12.5	260.6	11560.4	*****
10.1	18.0	5.7	*****	5.2	-11.5	48.2	12.0	263.6	11781.4	*****
11.8	18.3	5.4	*****	2.9	-13.7	47.6	12.3	261.7	11643.3	*****
13.5	19.3	7.0	*****	2.5	-13.7	47.2	12.7	258.9	11442.6	*****
15.1	19.3	7.2	*****	1.6	-13.7	46.5	13.2	255.7	11213.4	*****
16.4	19.5	8.4	*****	1.3	-13.9	46.2	13.5	254.5	11125.7	*****
17.8	21.0	9.2	*****	.7	-14.3	44.5	15.0	245.6	10480.9	*****
19.1	21.4	9.9	*****	.5	-14.8	43.6	15.8	241.7	10200.8	*****
20.5	22.4	11.1	*****	.2	-15.0	43.6	16.4	238.0	9934.7	*****
22.2	22.5	11.5	*****	-.1	-15.5	42.8	16.6	236.6	9833.1	*****
23.3	24.7	12.7	*****	-.7	-16.3	40.8	18.7	226.1	9076.8	*****
27.1	25.5	14.6	*****	-.9	-16.4	40.2	19.5	221.5	8751.0	*****
29.1	25.5	14.9	*****	-1.3	-17.0	40.2	19.5	221.5	8751.0	*****
31.1	25.5	14.5	*****	-1.6	-17.1	40.2	19.5	221.5	8751.0	*****
33.0	25.7	14.8	*****	-1.7	-17.2	40.0	19.7	220.5	8676.9	*****
34.8	26.9	15.1	*****	-1.9	-17.4	39.3	20.6	215.8	8337.7	*****
36.9	26.5	15.4	*****	-2.0	-17.9	39.1	20.8	215.1	8290.6	*****
38.2	27.4	15.8	*****	-2.1	-18.1	38.7	21.4	212.1	8068.4	*****
39.2	27.1	15.9	*****	-2.1	-18.3	38.2	21.3	217.2	8437.4	*****
41.7	28.5	16.9	*****	-2.1	-18.5	37.9	22.5	207.0	7704.6	*****
43.4	29.2	17.4	*****	-2.1	-18.6	37.4	23.2	203.6	7460.6	*****
45.2	29.7	20.1	*****	-2.1	-18.8	37.1	23.7	201.3	7297.1	*****
46.8	30.4	20.3	*****	-2.3	-19.1	36.4	24.3	196.4	6940.0	*****
48.8	31.0	19.0	36.9	-2.5	-19.2	36.3	25.0	195.3	6860.7	88.1

DISTANCE SHIP HAS TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 48.8

2

ANCHOR TEST

CED w/o BALLGUIDE

0=MOV 1=FIX
CHAIN, 270 FT - 3.0 IN CHAIN

ENGTH ON BOTTOM
EIGHT ON BOTTOM
CROWN DEPTH
SHANK TIP DEPTH

13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

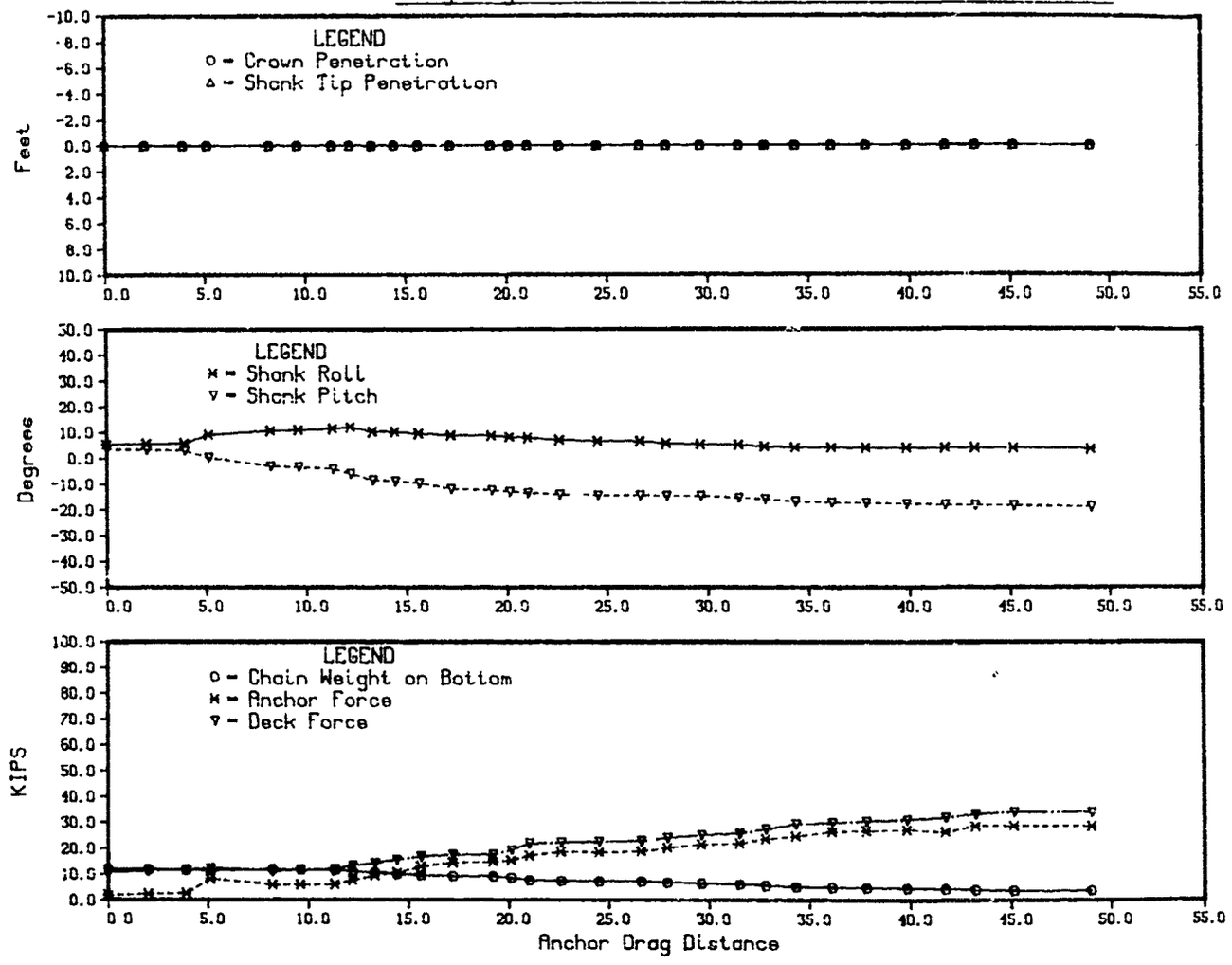
F	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
**	275.1	12610.2	*****	*****	*****	83.5	20610.2
**	274.3	12550.4	*****	*****	*****	83.5	20550.4
**	271.5	12350.0	*****	*****	*****	83.5	20350.0
**	264.8	11866.6	*****	*****	*****	83.5	19868.6
**	260.6	11560.4	*****	*****	*****	83.5	19560.4
**	263.6	11781.4	*****	*****	*****	83.5	19781.4
**	261.7	11643.3	*****	*****	*****	83.5	19643.3
**	258.9	11442.6	*****	*****	*****	83.5	19442.6
**	255.7	11213.4	*****	*****	*****	83.5	19213.4
**	254.5	11125.7	*****	*****	*****	83.5	19125.7
**	245.6	10480.9	*****	*****	*****	83.5	18480.9
**	241.7	10200.8	*****	*****	*****	83.5	18200.8
**	238.0	9934.7	*****	*****	*****	83.5	17934.7
**	236.6	9833.1	*****	*****	*****	83.5	17833.1
**	226.1	9076.8	*****	*****	*****	83.5	17076.8
**	221.5	8751.0	*****	*****	*****	83.5	16751.0
**	221.5	8751.0	*****	*****	*****	83.5	16751.0
**	221.5	8751.0	*****	*****	*****	83.5	16751.0
**	220.5	8676.9	*****	*****	*****	83.5	16676.9
**	215.8	8337.7	*****	*****	*****	83.5	16337.7
**	215.1	8290.6	*****	*****	*****	83.5	16290.6
**	212.1	8068.4	*****	*****	*****	83.5	16068.4
**	217.2	8437.4	*****	*****	*****	83.5	16437.4
**	207.0	7704.6	*****	*****	*****	83.5	15704.6
**	203.6	7460.6	*****	*****	*****	83.5	15460.6
**	201.3	7297.1	*****	*****	*****	83.5	15297.1
**	196.4	6940.0	*****	*****	*****	83.5	14940.0
*	195.3	6860.7	88.1	86.2		83.5	14860.7

3

Day # - 208
Test No. - 3
Test Series No. - C

INDIAN ISLAND

moorfast 6000 lb, 50 deg mov flukes
silty clay



TEST DATE	208
TEST NO.	3
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1149 - 1214
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	MOORFAST 6000 LB, 50 DEG MOV FLUKES
ANCHOR WEIGHT	6000.00 LB.
FLUKE ANGLE-TYPE,	50.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEE
2.0	17.0	1.9	*****	5.4	3.5	50.5	10.8	267.8	12082.4	****
2.8	17.5	2.4	*****	5.7	3.4	49.7	11.3	264.6	11853.3	****
3.9	17.1	2.5	*****	5.9	3.1	49.4	11.6	262.8	11722.9	****
5.1	16.5	4.1	*****	9.2	.4	48.3	12.3	256.2	11387.2	****
6.2	17.4	5.9	*****	10.7	-3.0	49.9	11.2	265.1	11890.4	****
7.0	18.0	6.9	*****	11.0	-3.4	49.0	11.8	261.3	11615.2	****
11.3	18.2	6.0	*****	11.5	-4.1	48.7	12.0	260.1	11527.0	****
12.2	19.5	7.5	*****	12.0	-6.0	47.0	13.3	251.9	10938.6	****
13.3	20.5	9.4	*****	10.3	-8.5	45.7	14.3	246.2	10528.3	****
14.4	21.8	10.4	*****	10.2	-9.0	44.3	15.6	239.0	10009.5	****
15.6	23.0	12.9	*****	9.5	-9.7	43.0	16.8	232.1	9508.2	****
17.2	23.7	14.4	*****	8.9	-11.9	42.4	17.5	228.0	9219.0	****
19.2	23.5	14.7	*****	8.7	-12.4	42.3	17.6	227.4	9173.1	****
20.1	25.5	15.3	*****	8.3	-13.0	40.8	19.3	218.8	8551.3	****
21.0	28.1	17.1	*****	7.9	-13.5	38.8	21.9	205.3	7584.8	****
22.6	28.6	18.7	*****	7.1	-14.0	38.4	22.4	203.5	7454.7	****
24.5	29.9	19.9	*****	6.6	-14.4	38.2	22.7	202.0	7343.9	****
26.4	29.1	19.4	*****	6.5	-14.4	38.1	22.9	200.5	7236.3	****
27.7	30.4	20.3	*****	5.7	-14.7	37.2	24.2	194.8	6828.6	****
29.5	31.4	21.5	*****	5.3	-14.7	36.6	25.2	190.2	6491.7	****
31.5	32.1	22.0	*****	5.2	-15.4	36.2	25.9	186.4	6223.5	****
32.8	33.7	23.7	*****	4.5	-15.9	35.3	27.5	179.2	5735.8	****
34.3	35.6	24.7	*****	4.1	-16.9	34.3	29.4	160.7	5143.6	****
36.1	36.2	25.5	*****	4.1	-17.3	34.0	30.0	155.1	4962.5	****
37.4	36.8	25.8	*****	4.0	-17.5	33.7	30.5	150.3	4808.5	****
39.3	37.3	27.2	*****	4.0	-17.7	33.5	31.1	144.1	4612.8	****
41.7	38.2	26.4	*****	4.0	-18.1	33.1	32.0	134.9	4316.6	****
43.2	39.5	28.7	*****	4.0	-18.3	32.5	33.3	125.0	3999.9	****
45.1	40.3	28.7	*****	3.9	-18.4	32.2	34.1	116.6	3731.0	****
49.0	40.3	28.6	*****	3.5	-18.9	32.2	34.1	117.2	3748.9	****

DISTANCE BARGE TRAVELLED 60.0
DISTANCE ANCHOR TRAVELLED 49.0

2

AST ANCHOR TEST

LAN
14
Y
000 LB, 50 DEG MOV FLUKES
LB.
- 0 0=MOV 1=FIX
.0 IN CHAIN, 270 FT - 3.0 IN CHAIN

IN

HAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
ANC HAIN WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
WAT ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
TOT ANCHOR SHANK TIP DEPTH CROWN

	9	10	11	12	13	14	15
T	PS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
*	.3	267.8	12082.4	*****	*****	*****	86.0	18082.4
*	.3	264.6	11853.3	*****	*****	*****	86.0	17853.3
*	.6	262.8	11722.9	*****	*****	*****	86.0	17722.9
*	.3	258.2	11387.2	*****	*****	*****	86.0	17387.2
*	.2	265.1	11890.4	*****	*****	*****	86.0	17890.4
*	.3	261.3	11615.2	*****	*****	*****	86.0	17615.2
*	.0	260.1	11527.0	*****	*****	*****	86.0	17527.0
*	.3	251.9	10938.6	*****	*****	*****	86.0	16938.6
*	.3	246.2	10528.3	*****	*****	*****	86.0	16528.3
*	.6	239.0	10009.5	*****	*****	*****	86.0	16009.5
*	.3	232.1	9508.2	*****	*****	*****	86.0	15508.2
*	.5	228.0	9219.0	*****	*****	*****	86.0	15219.0
*	.6	227.4	9173.1	*****	*****	*****	86.0	15173.1
*	.3	218.8	8551.3	*****	*****	*****	86.0	14551.3
*	.9	205.3	7584.8	*****	*****	*****	86.0	13584.8
*	.4	203.5	7454.7	*****	*****	*****	86.0	13454.7
*	.7	202.0	7343.9	*****	*****	*****	86.0	13343.9
*	.9	200.5	7236.3	*****	*****	*****	86.0	13236.3
*	.2	194.8	6828.6	*****	*****	*****	86.0	12828.6
*	.2	190.2	6491.7	*****	*****	*****	86.0	12491.7
*	.9	186.4	6223.5	*****	*****	*****	86.0	12223.5
*	.5	179.2	5735.8	*****	*****	*****	86.0	11735.8
*	.4	160.7	5143.6	*****	*****	*****	86.0	11143.6
*	.0	155.1	4962.5	*****	*****	*****	86.0	10962.5
*	.9	150.3	4808.5	*****	*****	*****	86.0	10808.5
*	.1	144.1	4612.8	*****	*****	*****	86.0	10612.8
*	.0	134.9	4316.6	*****	*****	*****	86.0	10316.6
*	.3	125.0	3999.9	*****	*****	*****	86.0	9999.9
*	.1	116.6	3731.0	*****	*****	*****	86.0	9731.0
*	.1	117.2	3748.9	*****	*****	*****	86.0	9748.9

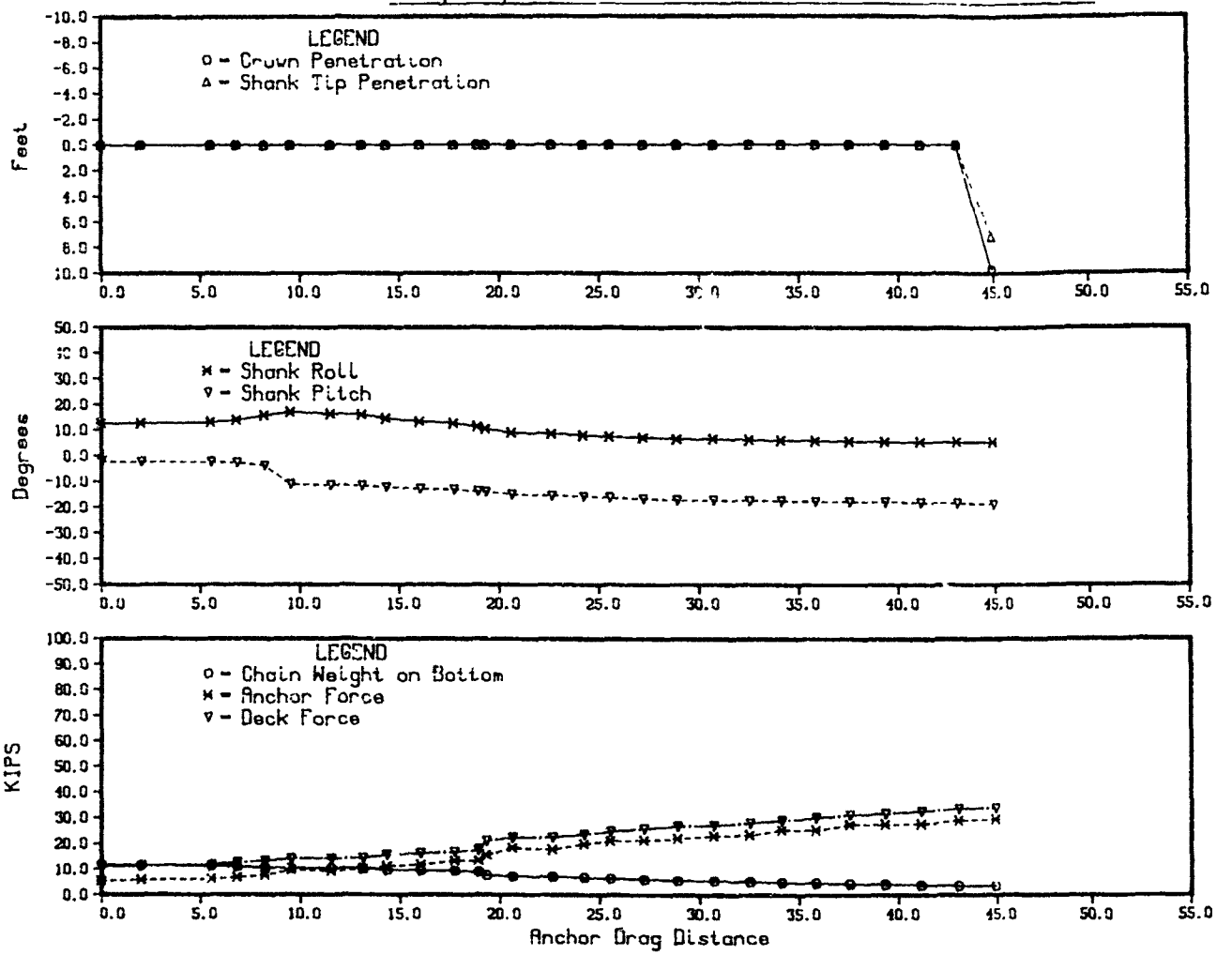
3

Day # - 208
Test No. - 4
Test Series No. - 0

INDIAN ISLAND

moorfast 6000 lb, 50 deg mov flukes

silty clay



MOORFAST ANCHOR TEST

TEST DATE	208
TEST NO.	4
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1228 - 1255
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	MOORFAST 6000 LB, 50 DEG MOV FLUKES
ANCHOR WEIGHT	6000.00 LB.
FLUKE ANGLE-TYPE,	50.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEE
0.0	17.5	9.4	*****	12.6	-2.1	50.4	11.2	262.7	11716.0	****
2.0	17.3	9.9	*****	12.7	-2.2	49.9	11.5	260.9	11584.4	****
5.5	18.3	9.3	*****	13.1	-2.2	49.2	11.9	258.1	11384.8	****
6.8	19.0	9.9	*****	13.9	-2.5	48.2	12.7	253.3	11036.0	****
8.2	19.7	7.7	*****	15.3	-3.6	47.2	13.4	248.2	10667.5	****
9.5	20.5	9.8	*****	17.0	-11.0	46.3	14.2	244.2	10379.2	****
11.5	20.5	9.2	*****	16.4	-11.2	46.3	14.2	244.2	10379.2	****
13.1	20.3	10.1	*****	16.1	-11.5	45.9	14.4	243.0	10298.9	****
14.3	22.0	11.2	*****	14.5	-12.1	44.6	15.7	235.5	9752.6	****
16.0	22.5	11.7	*****	13.3	-12.5	44.1	16.2	232.5	9542.0	****
17.7	23.0	13.2	*****	12.7	-13.1	43.6	16.7	229.7	9338.8	****
18.9	24.0	13.3	*****	11.4	-13.5	42.6	17.7	224.6	8970.4	****
19.3	27.5	15.5	*****	10.5	-13.9	39.7	21.1	205.8	7619.1	****
20.5	28.7	16.3	*****	9.0	-15.0	38.5	22.4	200.2	7212.6	***
22.6	28.9	17.7	*****	8.6	-15.4	38.7	22.5	198.9	7114.7	***
24.2	29.9	19.9	*****	8.0	-15.7	38.0	23.6	194.2	6783.5	***
25.5	31.1	21.1	*****	7.5	-16.1	37.2	24.8	189.1	6414.3	***
27.2	32.1	21.4	*****	7.2	-16.6	36.5	25.8	184.4	6079.2	***
28.9	33.2	22.3	*****	6.7	-17.1	36.0	26.9	177.5	5680.8	***
30.7	33.5	23.1	*****	6.7	-17.1	35.8	27.2	175.4	5613.4	***
32.5	34.5	23.5	*****	6.2	-17.3	35.3	28.1	164.2	5254.1	***
34.1	35.4	25.4	*****	6.1	-17.4	34.8	29.1	156.8	5017.0	***
35.9	36.4	25.3	*****	5.8	-17.7	34.3	30.1	147.0	4703.4	***
37.5	37.5	27.4	*****	5.7	-17.7	33.8	31.2	136.1	4355.2	***
39.3	38.1	27.5	*****	5.5	-17.8	33.5	31.8	131.0	4193.4	***
41.1	39.0	27.7	*****	5.5	-18.1	33.1	32.7	122.1	3907.7	***
43.0	40.0	29.3	*****	5.5	-18.3	32.7	33.6	111.6	3572.8	***
44.9	40.2	29.5		5.5	-18.7	32.6	33.9	110.7	3541.4	

DISTANCE BARGE TRAVELLED 56.0
DISTANCE ANCHOR TRAVELLED 44.9

2

ANCHOR TEST

8, 50 DEG MOV FLUKES

0=MOV 1=FIX
CHAIN, 270 FT - 3.0 IN CHAIN

NGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
IGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
ROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
HANK TIP DEPTH CROWN

9	10	11	12	13	14	15
EET	LBS	FEET	FEET	FEET	FEET	LBS
262.7	11716.0	*****	*****	*****	88.0	17716.0
260.9	11584.4	*****	*****	*****	88.0	17584.4
258.1	11384.8	*****	*****	*****	88.0	17384.8
253.3	11036.0	*****	*****	*****	88.0	17036.0
248.2	10667.5	*****	*****	*****	88.0	16667.5
244.2	10379.2	*****	*****	*****	88.0	16379.2
244.2	10379.2	*****	*****	*****	88.0	16379.2
243.0	10298.9	*****	*****	*****	88.0	16298.9
235.5	9752.6	*****	*****	*****	88.0	15752.6
232.5	9542.0	*****	*****	*****	88.0	15542.0
229.7	9338.8	*****	*****	*****	88.0	15338.8
224.6	8970.4	*****	*****	*****	88.0	14970.4
205.8	7619.1	*****	*****	*****	88.0	13619.1
200.2	7212.6	*****	*****	*****	88.0	13212.6
198.8	7114.7	*****	*****	*****	88.0	13114.7
194.2	6783.5	*****	*****	*****	88.0	12783.5
189.1	6414.3	*****	*****	*****	88.0	12414.3
184.4	6079.2	*****	*****	*****	88.0	12079.2
177.5	5680.8	*****	*****	*****	88.0	11680.8
175.4	5613.4	*****	*****	*****	88.0	11613.4
164.2	5254.1	*****	*****	*****	88.0	11254.1
156.8	5017.0	*****	*****	*****	88.0	11017.0
147.0	4703.4	*****	*****	*****	88.0	10703.4
136.1	4355.2	*****	*****	*****	88.0	10355.2
131.0	4193.4	*****	*****	*****	88.0	10193.4
122.1	3907.7	*****	*****	*****	88.0	9907.7
111.6	3572.8	*****	*****	*****	88.0	9572.8
110.7	3541.4				88.0	9541.4

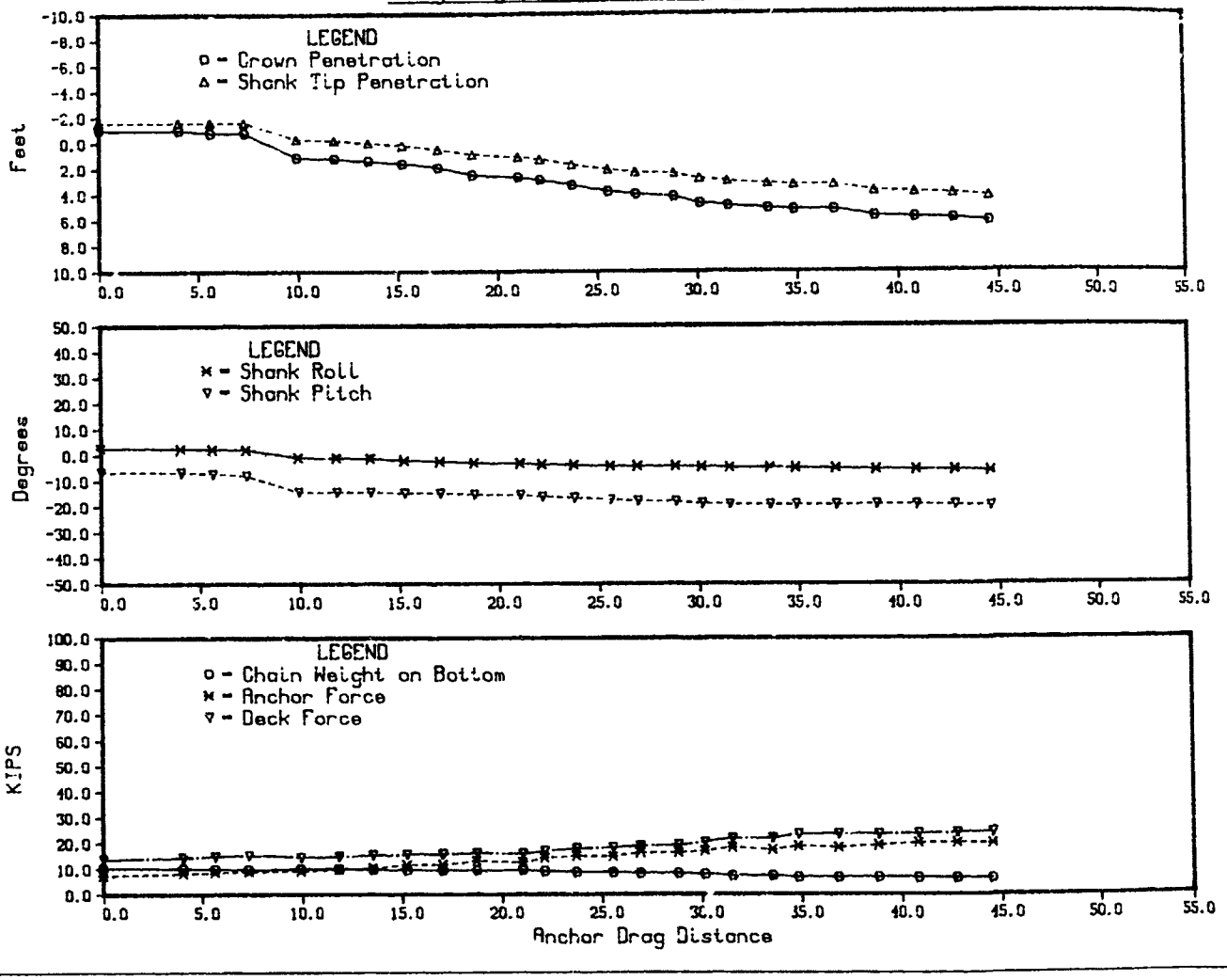
3

Day # - 208
Test No. - 5
Test Series No. - 0

INDIAN ISLAND

two fluke balanced w/ballguide

silty clay



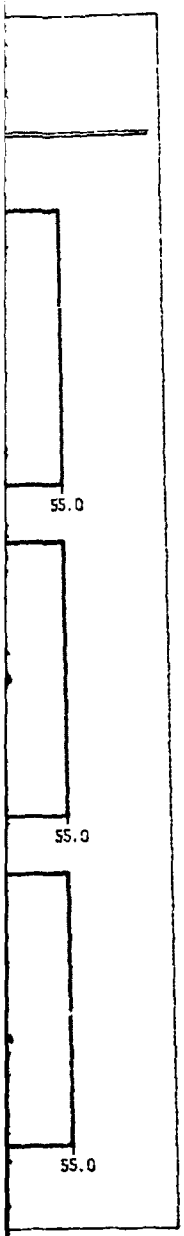
TWO FLUKE ANCHOR TEST

TEST DATE	208
TEST NO.	5
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1416 - 1424
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	TWO FLUKE BALANCED W/BALLGUIDE
ANCHOR WEIGHT	9800.00 LB.
FLUKE ANGLE-TYPE	40.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS
0.0	20.2	7.0	87.6	2.7	-6.4	46.9	13.8	245.1	10450.7
4.0	20.6	8.3	87.6	2.5	-6.6	46.2	14.4	241.5	10187.4
5.6	21.3	9.7	87.7	2.3	-7.2	45.6	14.9	238.6	9981.7
7.3	21.7	9.1	87.7	2.1	-7.5	45.2	15.3	236.1	9802.3
9.9	21.0	9.3	89.2	-1.0	-14.2	46.0	14.6	240.2	10093.9
11.8	21.2	9.9	89.3	-1.1	-14.2	45.8	14.8	238.9	10001.5
13.5	21.7	10.4	89.5	-1.4	-14.3	45.3	15.3	235.8	9775.7
15.2	22.0	11.6	89.7	-2.2	-14.6	44.9	15.6	234.3	9670.8
17.0	22.2	11.7	90.0	-2.6	-14.7	44.7	15.8	233.1	9584.6
18.7	22.5	13.1	90.5	-3.1	-15.2	44.3	16.1	231.7	9485.7
21.0	22.2	12.5	90.7	-3.3	-15.4	44.7	15.8	233.1	9584.6
22.1	23.3	14.3	90.9	-3.7	-16.1	43.5	16.9	227.3	9164.3
23.7	24.2	15.0	91.3	-3.9	-16.5	42.7	17.8	222.0	8785.4
25.5	24.6	14.7	91.7	-4.4	-17.3	42.3	18.2	219.9	8631.2
26.9	25.3	16.3	91.9	-4.3	-17.3	41.7	18.9	216.4	8382.9
28.8	25.6	15.3	92.1	-4.4	-18.1	41.4	19.2	214.7	8257.0
30.1	26.7	16.9	92.5	-4.6	-18.3	40.6	20.3	209.4	7873.9
31.5	28.1	18.2	92.7	-4.9	-19.1	39.5	21.7	202.0	7345.1
33.5	28.2	17.3	92.9	-5.0	-19.3	39.4	21.8	201.4	7300.6
34.8	29.8	18.7	93.0	-5.1	-19.3	38.3	23.4	193.7	6746.9
36.8	29.9	18.2	93.0	-5.3	-19.3	38.2	23.5	193.2	6709.6
38.9	29.8	19.1	93.5	-5.7	-19.2	38.3	23.4	193.8	6751.0
40.8	30.1	20.0	93.6	-5.8	-19.3	38.1	23.7	191.9	6619.0
42.7	30.4	20.1	93.7	-5.9	-19.5	37.9	24.0	190.5	6513.2
44.5	30.7	19.9	93.9	-6.3	-19.9	37.7	24.3	189.1	6417.6

DISTANCE BARGE TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 44.5



2

LUKE ANCHOR TEST

AND
4

BALANCED W/BALLGUIDE
LB.
- 0 0=MOV 1=FIX
.0 IN CHAIN, 270 FT - 3.0 IN CHAIN

AIN LENGTH ON BOTTOM
AIN WEIGHT ON BOTTOM
CHOR CROWN DEPTH
CHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

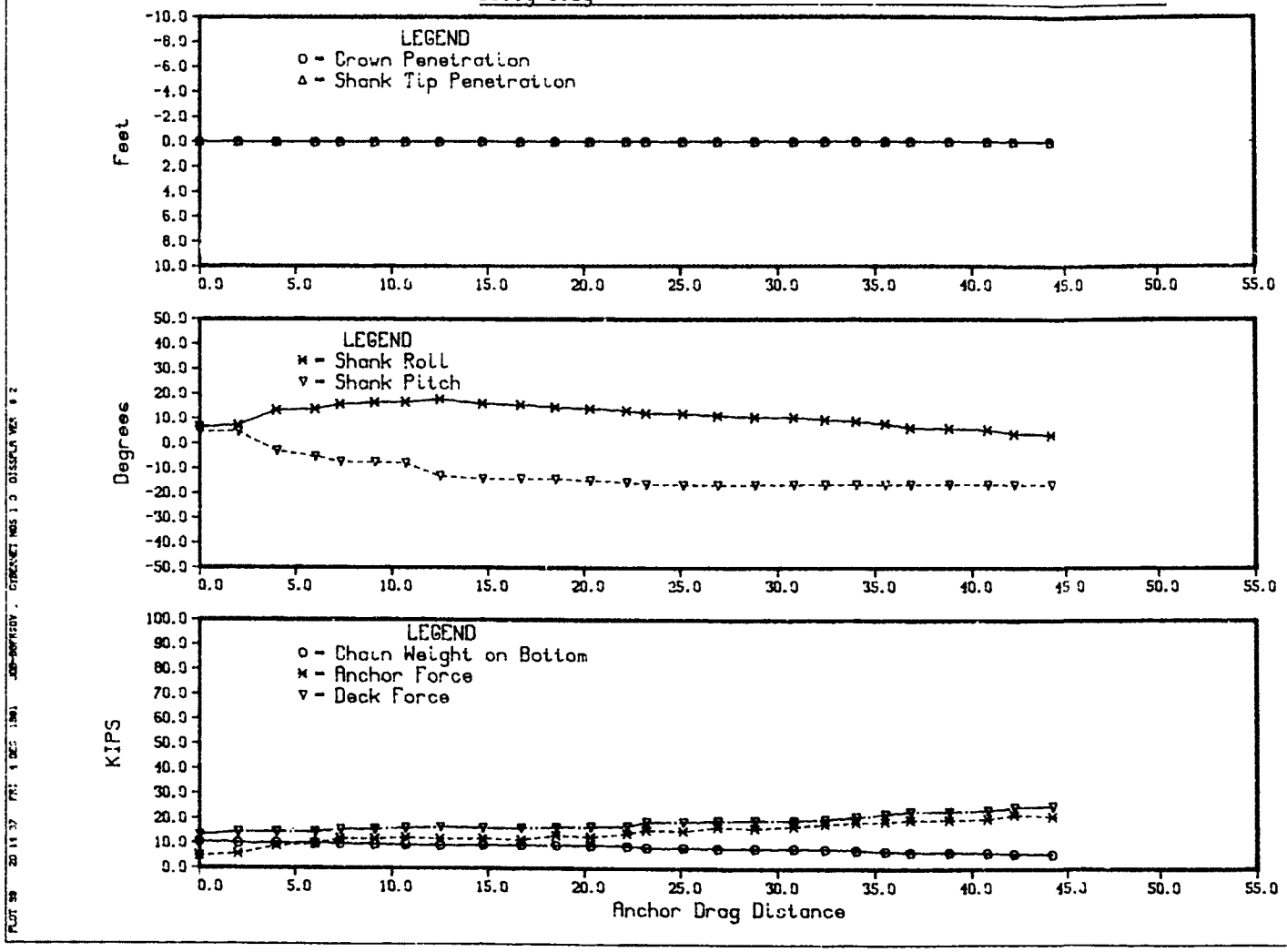
	9	10	11	12	13	14	15
PS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
.8	245.1	10450.7	88.0	87.4	90.5	89.0	20250.7
.4	241.5	10187.4	88.0	87.4	90.5	89.0	19987.4
.9	238.6	9981.7	88.2	87.4	90.6	89.0	19781.7
.3	236.1	9802.3	88.2	87.4	90.6	89.0	19602.3
.6	240.2	10093.9	90.1	88.7	92.0	89.0	19893.9
.8	238.9	10001.5	90.2	88.8	92.1	89.0	19801.5
.3	235.8	9775.7	90.4	89.0	92.3	89.0	19575.7
.6	234.3	9670.8	90.6	89.2	92.5	89.0	19470.8
.8	233.1	9584.6	90.9	89.5	92.8	89.0	19384.6
.1	231.7	9485.7	91.5	89.9	93.3	89.0	19285.7
.3	233.1	9584.6	91.7	90.1	93.5	89.0	19384.6
.9	227.3	9164.3	91.9	90.3	93.7	89.0	18964.3
.8	222.0	8785.4	92.3	90.7	94.1	89.0	18585.4
.2	219.9	8631.2	92.8	91.1	94.5	89.0	18431.2
.9	216.4	8382.9	93.0	91.3	94.7	89.0	18182.9
.4	214.7	8257.0	93.2	91.4	94.9	89.0	18057.0
.3	209.4	7873.9	93.7	91.8	95.3	89.0	17673.9
.7	202.0	7345.1	93.9	92.0	95.5	89.0	17145.1
.8	201.4	7300.6	94.1	92.2	95.7	89.0	17100.6
.4	193.7	6746.9	94.2	92.3	95.8	89.0	16546.9
.5	193.2	6709.6	94.2	92.3	95.8	89.0	16509.6
.4	193.8	6751.0	94.7	92.8	96.3	89.0	16551.0
.7	191.9	6619.0	94.8	92.9	96.4	89.0	16419.0
.0	190.5	6513.2	94.9	93.0	96.5	89.0	16313.2
.3	189.1	6417.6	95.1	93.2	96.7	89.0	16217.6

3

Day # = 208
Test No. = 6
Test Series No. = 0

INDIAN ISLAND

two fluke balanced w/ballguide
silty clay



TWO FLUKE ANCHOR TEST

TEST DATE	208
TEST NO.	6
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1548 - 1602
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	TWO FLUKE BALANCED W/BALLGUIDE
ANCHOR WEIGHT	9500.00 Lbs.
FLUKE ANGLE-TYPE	40.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	150 FT - 2.0 IN CHAIN, 270 FT - 3.0 I

1. DECK DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. LINE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. A
14. W
15. T

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	19.3	5.0	*****	6.6	4.3	47.7	13.3	247.1	10592.3	*****
2.0	21.0	5.7	*****	7.2	4.7	46.2	14.5	239.5	10043.0	*****
4.0	21.0	8.4	*****	13.2	-3.0	46.2	14.5	239.5	10043.0	*****
6.0	21.0	9.7	*****	13.7	-5.3	46.2	14.5	239.5	10043.0	*****
7.3	22.0	11.7	*****	15.5	-7.5	45.1	15.5	233.6	9616.5	*****
9.1	22.2	11.7	*****	16.3	-7.7	44.9	15.7	232.4	9529.7	*****
10.7	22.7	12.2	*****	16.5	-8.0	44.3	16.2	229.8	9346.0	*****
12.5	23.0	11.7	*****	17.6	-13.3	44.0	16.5	228.1	9222.9	*****
14.7	22.7	11.9	*****	15.8	-14.3	44.3	16.2	229.8	9346.0	*****
16.7	22.7	11.4	*****	15.4	-14.3	44.3	16.2	229.8	9346.0	*****
18.5	23.3	14.1	*****	14.4	-14.4	44.0	16.5	228.1	9222.9	*****
20.3	23.2	12.5	*****	13.9	-15.0	43.6	16.7	227.0	9142.3	*****
22.2	23.5	13.9	*****	13.1	-15.7	43.5	17.0	225.2	9011.8	*****
23.2	25.2	15.4	*****	12.0	-16.5	42.0	18.7	215.8	8334.6	*****
25.1	25.3	15.1	*****	11.8	-16.7	41.9	18.8	215.4	8310.4	*****
26.9	25.9	16.7	*****	11.0	-16.7	41.5	19.3	212.4	8090.9	*****
28.8	25.9	16.2	*****	10.4	-16.7	41.4	19.4	212.0	8065.2	*****
30.8	25.9	17.0	*****	10.4	-16.6	41.4	19.4	212.1	8072.0	*****
32.4	26.5	18.0	*****	9.5	-16.5	40.9	20.0	209.3	7866.9	*****
34.0	27.5	18.7	*****	8.8	-16.5	40.1	21.0	203.8	7471.9	*****
35.5	28.6	19.0	*****	7.9	-16.5	39.3	22.1	198.2	7073.7	*****
36.8	29.7	19.7	*****	8.2	-16.5	38.5	23.2	193.3	6719.4	*****
38.8	29.7	19.8	*****	6.0	-16.5	38.5	23.2	193.3	6719.4	*****
40.8	30.2	20.2	*****	5.5	-16.5	38.2	23.7	190.4	6507.5	*****
42.2	31.3	21.8	*****	3.9	-16.6	37.5	24.8	185.7	6167.4	*****
44.2	31.5	22.2	*****	3.4	-16.6	37.2	25.3	182.8	5960.5	*****

DISTANCE MARGE TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 44.2

2

ANCHOR TEST

NCED W/BALLGUIDE

0=MOV 1=FIX
N CHAIN, 270 FT - 3.0 IN CHAIN

LENGTH ON BOTTOM
WEIGHT ON BOTTOM
CROWN DEPTH
SHANK TIP DEPTH

13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
247.1	10592.3	*****	*****	*****	89.8	20092.3
239.5	10043.0	*****	*****	*****	89.8	19543.0
239.5	10043.0	*****	*****	*****	89.8	19543.0
239.5	10043.0	*****	*****	*****	89.8	19543.0
233.6	9616.5	*****	*****	*****	89.8	19116.5
232.4	9529.7	*****	*****	*****	89.8	19029.7
229.8	9346.0	*****	*****	*****	89.8	18846.0
228.1	9222.9	*****	*****	*****	89.8	18722.9
229.8	9346.0	*****	*****	*****	89.8	18846.0
229.8	9346.0	*****	*****	*****	89.8	18846.0
228.1	9222.9	*****	*****	*****	89.8	18722.9
227.0	9142.3	*****	*****	*****	89.8	18642.3
225.2	9011.8	*****	*****	*****	89.8	18511.8
215.8	8334.6	*****	*****	*****	89.8	17834.6
215.4	8310.4	*****	*****	*****	89.8	17810.4
212.4	8090.9	*****	*****	*****	89.8	17590.9
212.0	8065.2	*****	*****	*****	89.8	17565.2
212.1	8072.0	*****	*****	*****	89.8	17572.0
209.3	7866.9	*****	*****	*****	89.8	17366.9
203.8	7471.9	*****	*****	*****	89.8	16971.9
198.2	7073.7	*****	*****	*****	89.8	16573.7
193.3	6719.4	*****	*****	*****	89.8	16219.4
193.3	6719.4	*****	*****	*****	89.8	16219.4
190.4	6507.5	*****	*****	*****	89.8	16007.5
185.7	6167.4	*****	*****	*****	89.8	15667.4
182.8	5960.5	*****	*****	*****	89.8	15460.5

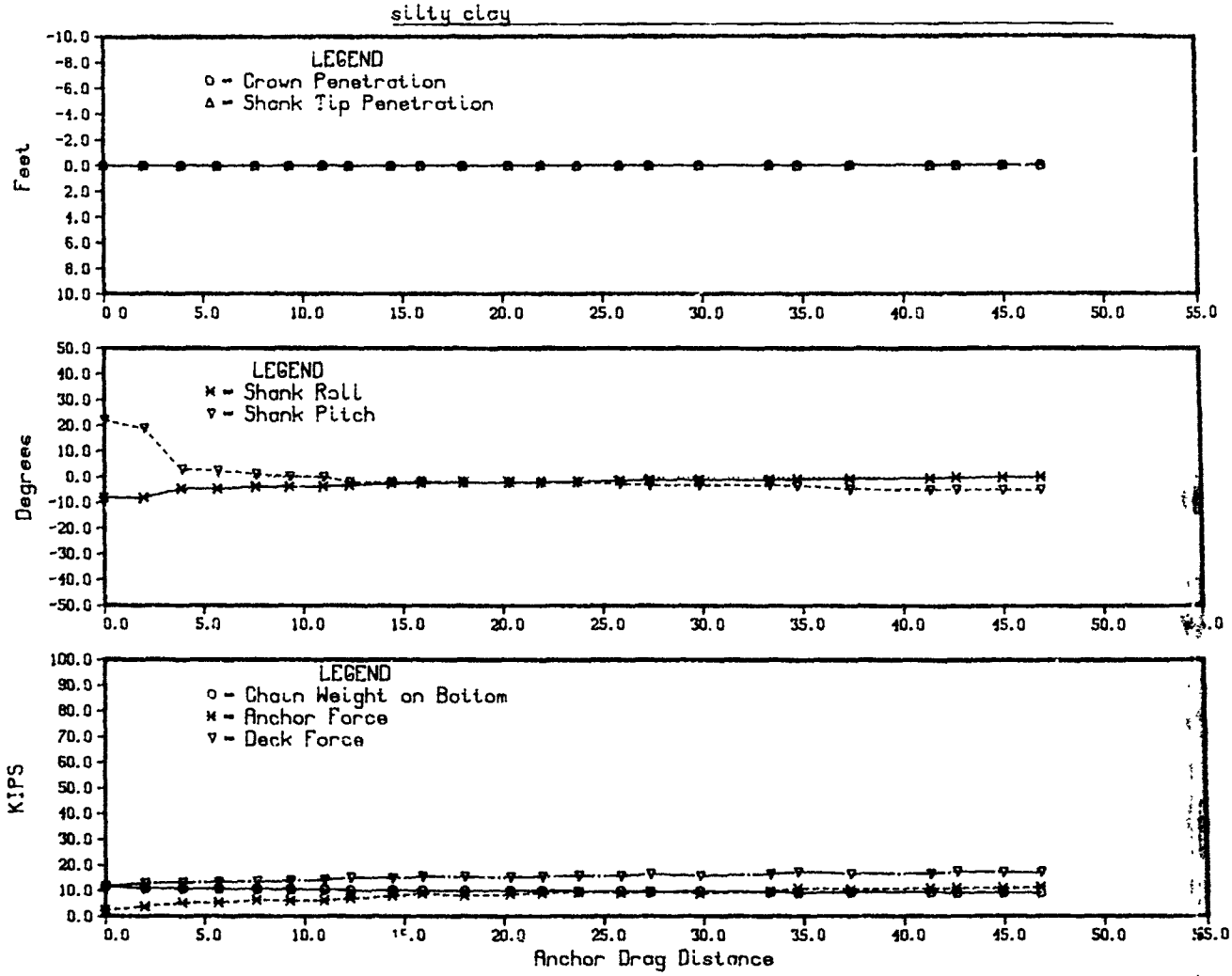
3

Day # = 208
Test No. = 7
Test Series No. = 0

INDIAN ISLAND

bruce twin shank

silty clay



BRUCE TWIN ANCHOR TEST

TEST DATE	208
TEST NO.	7
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1703 - 1720
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	BRUCE TWIN SHANK
ANCHOR WEIGHT	1100.00 LB.
FLUKE ANGLE-TYPE,	***** DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0 IN C

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCH
14. WATE
15. TOTA

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	18.0	2.3	*****	-5.2	21.9	49.6	11.6	259.1	11451.7	*****
2.0	19.3	3.8	*****	-6.2	18.7	48.0	12.9	250.8	10857.3	*****
3.9	19.5	5.2	*****	-4.7	2.9	47.8	13.1	249.4	10754.3	*****
5.7	19.7	5.3	*****	-4.7	2.4	47.5	13.3	248.3	10675.6	*****
7.6	19.9	6.2	*****	-4.0	1.0	47.3	13.5	246.9	10575.2	*****
9.3	20.2	5.0	*****	-3.9	.2	46.9	13.8	245.1	10450.7	*****
11.0	20.5	6.-	*****	-3.8	-.1	46.5	14.1	243.5	10329.8	*****
12.3	21.4	6.3	*****	-3.3	-2.1	45.5	15.0	238.0	9936.4	*****
14.4	21.2	7.8	*****	-2.5	-2.1	45.7	14.8	239.3	10027.3	*****
15.9	21.8	8.9	*****	-2.3	-1.9	45.0	15.4	235.9	9785.1	*****
18.0	21.7	7.9	*****	-2.2	-2.3	45.1	15.3	236.5	9829.0	*****
20.3	21.5	8.4	*****	-2.2	-2.3	45.4	15.1	237.4	9891.4	*****
21.9	22.1	8.9	*****	-2.2	-2.2	45.0	15.4	235.9	9785.1	*****
23.7	22.2	9.4	*****	-1.8	-2.1	44.6	15.8	233.5	9612.2	*****
25.8	22.0	8.9	*****	-1.4	-2.7	44.8	15.6	234.7	9698.0	*****
27.3	22.5	9.5	*****	-1.0	-3.1	44.0	16.4	230.0	9361.8	*****
29.4	22.1	8.8	*****	-1.0	-3.2	44.7	15.7	234.1	9655.0	*****
33.3	22.6	9.5	*****	-1.0	-3.2	44.0	16.4	230.1	9367.5	*****
34.7	23.6	10.7	*****	-.7	-3.4	43.2	17.2	225.8	9059.7	*****
37.3	22.9	10.4	*****	-.6	-4.7	43.9	16.5	229.4	9315.3	*****
41.3	22.9	10.7	*****	-.3	-4.9	43.9	16.5	229.3	9312.5	*****
42.6	23.7	10.8	*****	-.0	-4.8	43.1	17.3	225.2	9015.5	*****
44.9	23.5	10.6	*****	.1	-4.9	43.3	17.1	226.0	9071.3	*****
46.8	23.5	11.3	*****	.2	-4.9	43.3	17.1	226.2	9089.2	*****

DISTANCE BARGE TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 46.8

2

BRUCE TWIN ANCHOR TEST

8
7
0
DIAN ISLAND
03 - 1720
LTY CLAY
UCE TWIN SHANK
1100.00 LB.
*** DEG. - 1 0=MOV 1=FIX
0 FT - 2.0 IN CHAIN, 270 FT - 3.0 IN CHAIN

9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

7 EG	8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
9.8	11.6	259.1	11451.7	*****	*****	*****	88.8	12551.7
8.0	12.9	250.8	10857.3	*****	*****	*****	88.8	11957.3
7.8	13.1	249.4	10754.3	*****	*****	*****	88.8	11854.3
7.5	13.3	248.3	10675.6	*****	*****	*****	88.8	11775.6
7.3	13.5	246.9	10575.2	*****	*****	*****	88.8	11675.2
6.9	13.8	245.1	10450.7	*****	*****	*****	88.8	11550.7
6.5	14.1	243.5	10329.8	*****	*****	*****	88.8	11429.8
5.5	15.0	238.0	9936.4	*****	*****	*****	88.8	11036.4
5.7	14.8	239.3	10027.3	*****	*****	*****	88.8	11127.3
5.0	15.4	235.9	9785.1	*****	*****	*****	88.8	10885.1
5.1	15.3	236.5	9829.0	*****	*****	*****	88.8	10929.0
5.4	15.1	237.4	9891.4	*****	*****	*****	88.8	10991.4
5.0	15.4	235.9	9785.1	*****	*****	*****	88.8	10885.1
4.6	15.8	233.5	9612.2	*****	*****	*****	88.8	10712.2
4.8	15.6	234.7	9698.0	*****	*****	*****	88.8	10798.0
4.0	16.4	230.0	9361.8	*****	*****	*****	88.8	10461.8
4.7	15.7	234.1	9655.0	*****	*****	*****	88.8	10755.0
4.0	16.4	230.1	9367.5	*****	*****	*****	88.8	10467.5
3.2	17.2	225.8	9059.7	*****	*****	*****	88.8	10159.7
3.9	16.5	229.4	9315.3	*****	*****	*****	88.8	10415.3
3.9	16.5	229.3	9312.5	*****	*****	*****	88.8	10412.5
3.1	17.3	225.2	9015.5	*****	*****	*****	88.8	10115.5
3.3	17.1	226.0	9071.3	*****	*****	*****	88.8	10171.3
3.3	17.1	226.2	9089.2	*****	*****	*****	88.8	10189.2

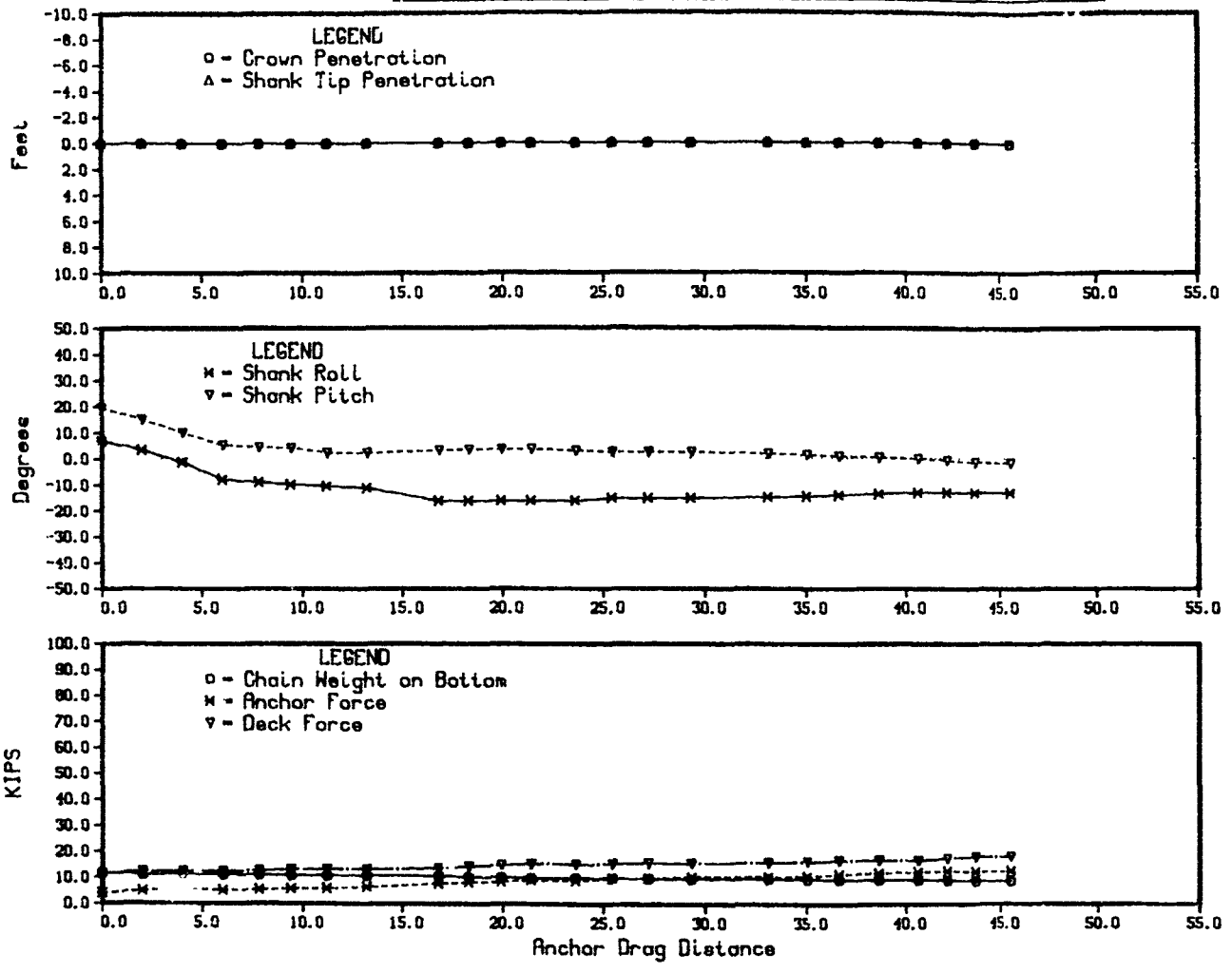
3

Day # - 208
Test No. - 8
Test Series No. - 0

INDIAN ISLAND

bruce twin shank

silty clay



BRUCE TWIN ANCHOR TEST

TEST DATE	208
TEST NO.	6
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1733 - 1746
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	BRUCE TWIN SHANK
ANCHOR WEIGHT	1100.00 LB.
FLUKE ANGLE-TYPE,	***** DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	1 FE
0.0	17.9	4.1	*****	6.8	19.4	49.9	11.5	260.9	11584.4	***
2.0	18.7	5.0	*****	3.4	15.2	48.6	12.4	255.2	11172.9	***
4.0	18.7	5.7	*****	-1.4	10.0	48.6	12.4	255.2	11172.9	***
6.0	18.7	5.1	*****	-7.9	5.3	48.6	12.4	255.2	11172.9	***
7.8	18.9	5.4	*****	-9.0	4.4	48.3	12.6	254.0	11086.3	***
9.4	19.4	5.8	*****	-9.9	4.1	47.7	13.1	250.7	10851.2	**
11.2	19.6	6.0	*****	-10.5	2.3	47.4	13.3	249.6	10772.5	**
13.2	19.5	6.5	*****	-11.2	2.2	47.5	13.2	250.3	10823.1	**
16.8	20.0	7.7	*****	-16.2	3.2	46.9	13.7	247.2	10596.8	**
18.3	20.7	8.2	*****	-16.2	3.5	46.1	14.4	242.8	10284.6	**
19.9	21.2	8.6	*****	-16.2	3.5	45.5	14.9	240.0	10079.1	**
21.4	21.7	9.1	*****	-16.2	3.6	44.9	15.4	237.3	9882.6	**
23.6	21.5	9.4	*****	-16.2	3.0	45.1	15.2	238.5	9970.7	**
25.4	21.7	9.6	*****	-15.2	2.4	44.9	15.4	237.3	9882.6	**
27.2	22.1	9.9	*****	-15.2	2.4	44.5	15.8	234.9	9709.9	**
29.3	22.0	10.6	*****	-15.1	2.4	44.6	15.7	235.5	9752.6	**
33.1	22.2	10.4	*****	-14.8	1.8	44.4	15.9	234.3	9667.5	**
35.0	22.5	10.6	*****	-14.5	1.4	44.1	16.2	232.5	9542.0	**
36.6	23.0	11.4	*****	-14.0	.9	43.6	16.7	229.7	9338.8	**
38.6	23.1	11.9	*****	-13.5	.4	43.5	16.8	229.2	9299.0	**
40.6	23.1	12.2	*****	-13.0	-.1	43.5	16.7	229.0	9287.3	**
42.1	23.8	12.6	*****	-13.0	-.7	42.8	17.5	225.4	9026.2	**
43.6	24.4	12.3	*****	-13.0	-1.4	42.2	18.1	222.5	8819.5	**
45.6	24.4	12.5	*****	-13.0	-1.7	42.2	18.1	222.5	8819.5	**

55.0

55.0

55.0

DISTANCE MARK TRAVELLED 50.0
DISTANCE ANCHOR TRAVELLED 45.6

2

UCE TWIN ANCHOR TEST

ISLAND
1746
LAY
WIN SHANK
00 LB.
EG. - 1 0=MOV 1=FIX
- 2.0 IN CHAIN, 270 FT - 3.0 IN CHAIN

CHAIN LENGTH ON BOTTOM
CHAIN WEIGHT ON BOTTOM
ANCHOR CROWN DEPTH
ANCHOR SHANK TIP DEPTH
13. ANCHOR FLUKE TIP DEPTH
14. WATER DEPTH
15. TOTAL BOTTOM WEIGHT

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

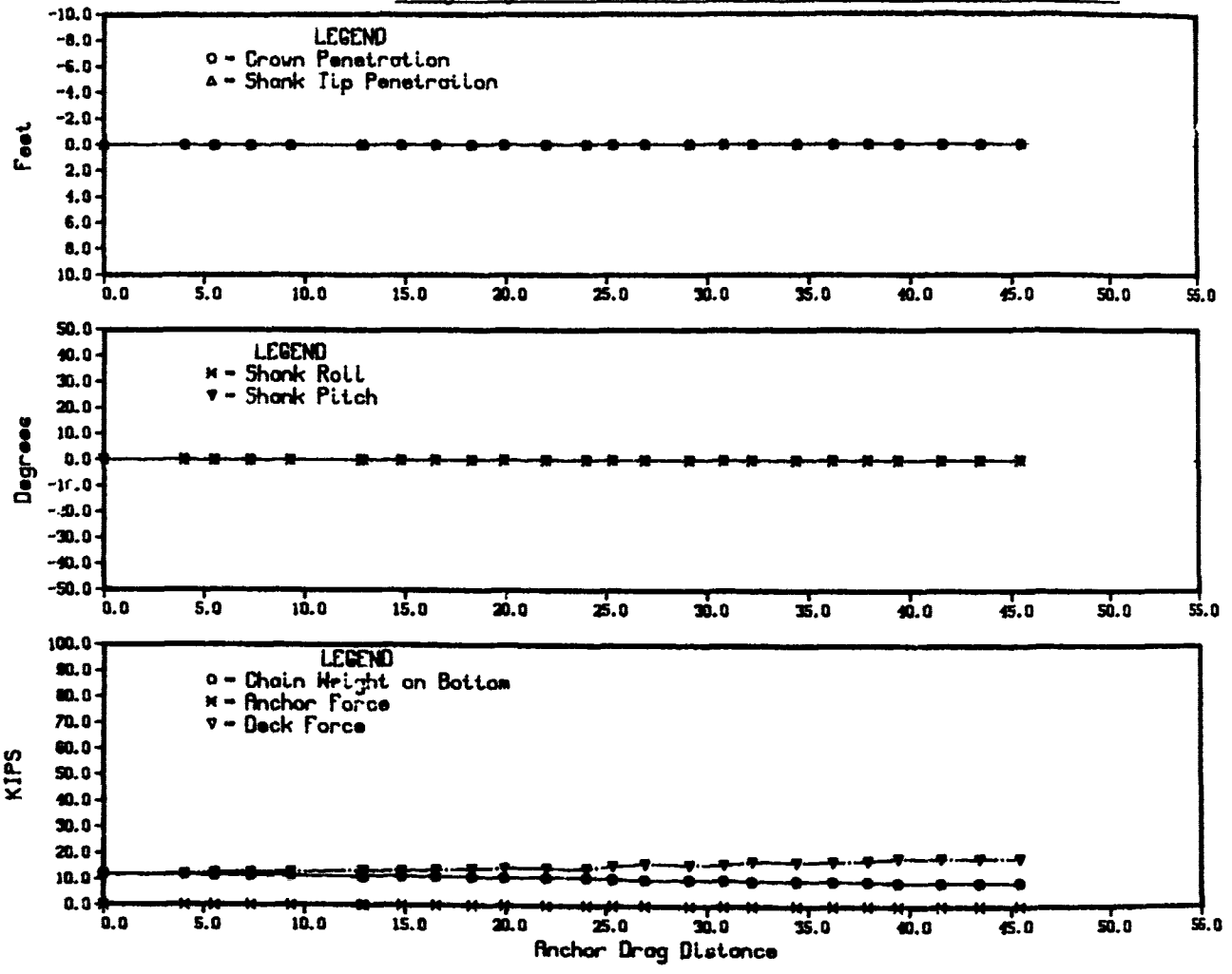
8 KIPS	9 FEET	10 LBS	11 FEET	12 FEET	13 FEET	14 FEET	15 LBS
11.5	260.9	11584.4	*****	*****	*****	88.0	12684.4
12.4	255.2	11172.9	*****	*****	*****	88.0	12272.9
12.4	255.2	11172.9	*****	*****	*****	88.0	12272.9
12.4	255.2	11172.9	*****	*****	*****	88.0	12272.9
12.6	254.0	11086.3	*****	*****	*****	88.0	12186.3
13.1	250.7	10851.2	*****	*****	*****	88.0	11951.2
13.3	249.6	10772.5	*****	*****	*****	88.0	11872.5
13.2	250.3	10823.1	*****	*****	*****	88.0	11923.1
13.7	247.2	10596.8	*****	*****	*****	88.0	11696.8
14.4	242.8	10284.6	*****	*****	*****	88.0	11384.6
14.9	240.0	10079.1	*****	*****	*****	88.0	11179.1
15.4	237.3	9882.6	*****	*****	*****	88.0	10982.6
15.2	238.5	9970.7	*****	*****	*****	88.0	11070.7
15.4	237.3	9882.6	*****	*****	*****	88.0	10982.6
15.8	234.9	9709.9	*****	*****	*****	88.0	10809.9
15.7	235.5	9752.6	*****	*****	*****	88.0	10852.6
15.9	234.3	9667.5	*****	*****	*****	88.0	10767.5
16.2	232.5	9542.0	*****	*****	*****	88.0	10642.0
16.7	229.7	9338.8	*****	*****	*****	88.0	10438.8
16.8	229.2	9299.0	*****	*****	*****	88.0	10399.0
16.7	229.0	9287.3	*****	*****	*****	88.0	10387.3
17.5	225.4	9026.2	*****	*****	*****	88.0	10126.2
18.1	222.5	8819.5	*****	*****	*****	88.0	9919.5
18.1	222.5	8819.5	*****	*****	*****	88.0	9919.5

3

Day # - 209
Test No. - 9
Test Series No. - 0

INDIAN ISLAND

prisma with cutter
silty clay



PRISMA ANCHOR TEST

TEST DATE	209
TEST NO.	9
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1009 - 1027
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	PRISMA WITH CUTTER
ANCHOR WEIGHT	1895.00 LB.
FLUKE ANGLE-TYPE.	50.00 DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	1 FE
0.0	18.0	*****	*****	*****	*****	47.8	12.1	264.8	11865.5	***
4.0	18.0	*****	*****	*****	*****	47.8	12.1	264.8	11865.5	***
5.5	18.5	*****	*****	*****	*****	47.1	12.6	261.8	11648.0	***
7.3	18.7	*****	*****	*****	*****	46.8	12.8	260.7	11568.3	***
9.3	18.8	*****	*****	*****	*****	46.7	12.9	260.0	11517.9	***
12.9	19.2	*****	*****	*****	*****	47.1	13.3	251.6	10915.4	***
12.8	19.3	*****	*****	*****	*****	46.0	13.4	257.2	11316.7	***
14.8	19.3	*****	*****	*****	*****	46.0	13.4	257.2	11316.7	***
16.5	19.7	*****	*****	*****	*****	45.5	13.8	254.8	11149.0	***
18.3	20.0	*****	*****	*****	*****	45.2	14.1	252.9	11008.6	***
19.9	20.5	*****	*****	*****	*****	44.6	14.6	250.1	10805.9	***
22.0	20.3	*****	*****	*****	*****	44.8	14.4	251.3	10895.9	***
24.0	20.3	*****	*****	*****	*****	44.6	14.4	251.3	10895.9	***
25.3	21.4	*****	*****	*****	*****	43.6	15.5	245.0	10442.1	***
26.9	22.2	*****	*****	*****	*****	42.8	16.3	240.4	10107.9	***
29.1	21.9	*****	*****	*****	*****	43.1	16.0	242.1	10233.5	***
30.6	22.1	*****	*****	*****	*****	42.9	16.2	241.3	10170.2	***
32.2	23.2	*****	*****	*****	*****	41.8	17.3	235.4	9748.5	***
34.4	23.0	*****	*****	*****	*****	42.0	17.1	236.1	9798.1	***
36.2	23.2	*****	*****	*****	*****	41.8	17.3	235.4	9751.5	***
37.9	23.6	*****	*****	*****	*****	41.4	17.7	233.3	9599.2	***
39.4	24.6	*****	*****	*****	*****	40.5	18.7	228.1	9220.3	***
41.5	24.5	*****	*****	*****	*****	40.6	18.6	228.6	9259.3	***
43.4	24.5	*****	*****	*****	*****	40.6	18.6	228.7	9269.0	***
45.4	24.5	*****	*****	*****	*****	40.6	18.6	228.7	9269.0	***

DISTANCE BARGE TRAVELLED 20.0
DISTANCE ANCHOR TRAVELLED 45.4

2

NCHOR TEST

TTER

0=MOV 1=FIX
AIN, 270 FT - 3.0 IN CHAIN

TH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
HT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
WN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
NK TIP DEPTH CROWN

	10	11	12	13	14	15
T	LBS	FEET	FEET	FEET	FEET	LBS
.8	11865.5	*****	*****	*****	82.0	13760.5
.8	11865.5	*****	*****	*****	82.0	13760.5
.8	11648.0	*****	*****	*****	82.0	13543.0
.7	11568.3	*****	*****	*****	82.0	13463.3
.0	11517.9	*****	*****	*****	82.0	13412.9
.6	10915.4	*****	*****	*****	82.0	12810.4
.2	11316.7	*****	*****	*****	82.0	13211.7
.2	11316.7	*****	*****	*****	82.0	13211.7
.8	11149.0	*****	*****	*****	82.0	13044.0
.9	11008.6	*****	*****	*****	82.0	12903.6
.1	10805.9	*****	*****	*****	82.0	12700.9
.3	10895.9	*****	*****	*****	82.0	12790.9
.3	10895.9	*****	*****	*****	82.0	12790.9
.0	10442.1	*****	*****	*****	82.0	12337.1
.4	10107.9	*****	*****	*****	82.0	12002.9
.1	10233.5	*****	*****	*****	82.0	12128.5
.3	10170.2	*****	*****	*****	82.0	12065.2
.4	9748.5	*****	*****	*****	82.0	11643.5
.1	9798.1	*****	*****	*****	82.0	11693.1
.4	9751.5	*****	*****	*****	82.0	11646.5
.3	9599.2	*****	*****	*****	82.0	11494.2
.1	9220.3	*****	*****	*****	82.0	11115.3
.6	9259.3	*****	*****	*****	82.0	11154.3
.7	9269.0	*****	*****	*****	82.0	11164.0
.7	9269.0	*****	*****	*****	82.0	11164.0

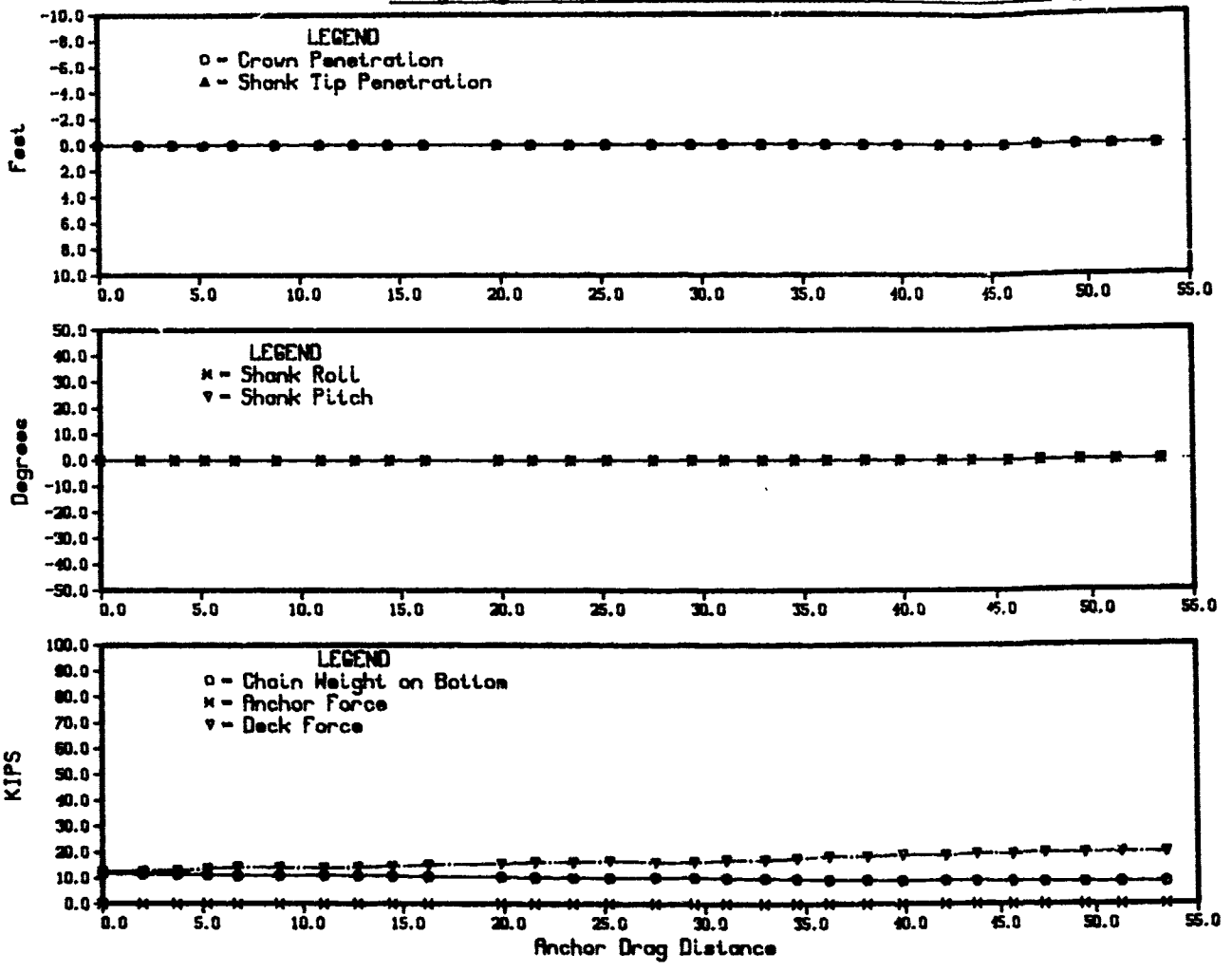
3

Day # - 209
Test No. - 10
Test Series No. - 0

INDIAN ISLAND

prisma with cutter

silty clay



PRISMA ANCHOR TEST

TEST DATE	209
TEST NO.	10
TEST RUN	9
TEST AREA	INDIAN ISLAND
START-END TIMES	1119 - 1135
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	PRISMA WITH CUTTER
ANCHOR WEIGHT	1895.00 LB.
FLUKE ANGLE-TYPE	50.00 DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	180 FT - 2.0 IN CHAIN, 270 FT - 3.0

1. DRAG DISTANCE
2. DECK TENSION
3. ANCHOR TENSION
4. PACKAGE DEPTH
5. ROTATION ANGLE
6. SHANK ANGLE
7. WIRE ROPE ANGLE
8. DECK HORIZ. FORCE
9. CHAIN LENGTH ON BOTTOM
10. CHAIN WEIGHT ON BOTTOM
11. ANCHOR CROWN DEPTH
12. ANCHOR SHANK TIP DEPTH
13.
14.
15.

1	2	3	4	5	6	7	8	9	10	11
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEE
5.0	13.4	*****	*****	*****	*****	47.4	12.5	261.9	11655.8	****
6.3	12.1	*****	*****	*****	*****	47.2	12.6	261.5	11626.0	****
3.7	13.3	*****	*****	*****	*****	46.6	12.9	259.7	11495.4	****
5.2	13.5	*****	*****	*****	*****	45.9	13.6	255.5	11196.5	****
5.7	26.2	*****	*****	*****	*****	45.1	14.3	251.3	10891.5	****
6.1	25.8	*****	*****	*****	*****	45.3	14.1	252.6	10984.0	****
18.3	14.3	*****	*****	*****	*****	45.6	13.9	253.5	11053.4	****
19.7	20.2	*****	*****	*****	*****	45.1	14.3	251.3	10891.5	****
24.4	20.3	*****	*****	*****	*****	44.7	14.6	249.7	10780.4	****
26.2	21.0	*****	*****	*****	*****	44.2	15.1	246.7	10559.5	****
29.6	21.3	*****	*****	*****	*****	43.6	15.6	244.0	10365.0	****
21.3	22.0	*****	*****	*****	*****	43.1	16.1	241.1	10162.4	****
23.4	22.0	*****	*****	*****	*****	43.1	16.1	241.3	10173.6	****
25.2	22.3	*****	*****	*****	*****	42.6	16.6	238.4	9961.6	****
27.3	21.9	*****	*****	*****	*****	43.2	16.0	241.8	10208.4	****
29.4	22.1	*****	*****	*****	*****	43.0	16.2	240.7	10127.8	****
31.3	22.3	*****	*****	*****	*****	42.3	16.9	236.9	9855.3	****
33.9	22.5	*****	*****	*****	*****	42.3	16.9	236.9	9858.3	****
34.5	23.4	*****	*****	*****	*****	41.7	17.5	233.9	9639.7	****
36.1	24.1	*****	*****	*****	*****	40.9	18.4	229.1	9296.2	****
38.0	24.2	*****	*****	*****	*****	40.8	18.4	229.3	9312.3	****
39.8	25.0	*****	*****	*****	*****	40.3	19.1	225.2	9016.9	****
42.9	24.7	*****	*****	*****	*****	40.6	18.8	226.8	9129.2	****
43.8	25.1	*****	*****	*****	*****	40.1	19.4	223.9	8920.6	****
45.7	25.1	*****	*****	*****	*****	40.1	19.4	223.7	8907.1	****
47.4	25.3	*****	*****	*****	*****	39.7	19.9	221.3	8737.1	****
49.4	25.3	*****	*****	*****	*****	39.7	19.9	221.2	8723.3	****
52.2	25.9	*****	*****	*****	*****	39.4	20.1	220.6	8686.5	****
53.4	25.9	*****	*****	*****	*****	39.6	20.0	220.6	8683.8	****

DISTANCE (DRAG TRAVELLED) 53.3
DISTANCE ANCHOR TRAVELLED 53.4

2

HOR TEST

R

MOV 1=FIX
N, 270 FT - 3.0 IN CHAIN

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H ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
N DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
K TIP DEPTH CROWN

	10	11	12	13	14	15
	LBS	FEET	FEET	FEET	FEET	LBS
* 9	11655.8	*****	*****	*****	82.5	13550.8
* 5	11626.0	*****	*****	*****	82.5	13521.0
* 7	11495.4	*****	*****	*****	82.5	13390.4
* 5	11196.5	*****	*****	*****	82.5	13091.5
* 8	10891.5	*****	*****	*****	82.5	12786.5
* 5	10984.0	*****	*****	*****	82.5	12879.0
* 6	11053.4	*****	*****	*****	82.5	12948.4
* 8	10891.5	*****	*****	*****	82.5	12786.5
* 7	10780.4	*****	*****	*****	82.5	12675.4
* 7	10559.5	*****	*****	*****	82.5	12454.5
* 9	10365.0	*****	*****	*****	82.5	12260.0
* 1	10162.4	*****	*****	*****	82.5	12057.4
* 8	10173.6	*****	*****	*****	82.5	12068.6
* 4	9961.6	*****	*****	*****	82.5	11856.6
* 8	10208.4	*****	*****	*****	82.5	12103.4
* 7	10127.8	*****	*****	*****	82.5	12022.8
* 9	9855.3	*****	*****	*****	82.5	11750.3
* 9	9858.3	*****	*****	*****	82.5	11753.3
* 0	9639.7	*****	*****	*****	82.5	11534.7
* 1	9296.2	*****	*****	*****	82.5	11191.2
* 8	9312.3	*****	*****	*****	82.5	11207.3
* 2	9016.9	*****	*****	*****	82.5	10911.9
* 8	9129.2	*****	*****	*****	82.5	11024.2
* 9	8920.6	*****	*****	*****	82.5	10815.6
* 7	8907.1	*****	*****	*****	82.5	10802.1
* 8	8737.1	*****	*****	*****	82.5	10632.1
* 2	8723.3	*****	*****	*****	82.5	10618.3
* 6	8586.5	*****	*****	*****	82.5	10581.5
* 6	8683.8	*****	*****	*****	82.5	10578.8

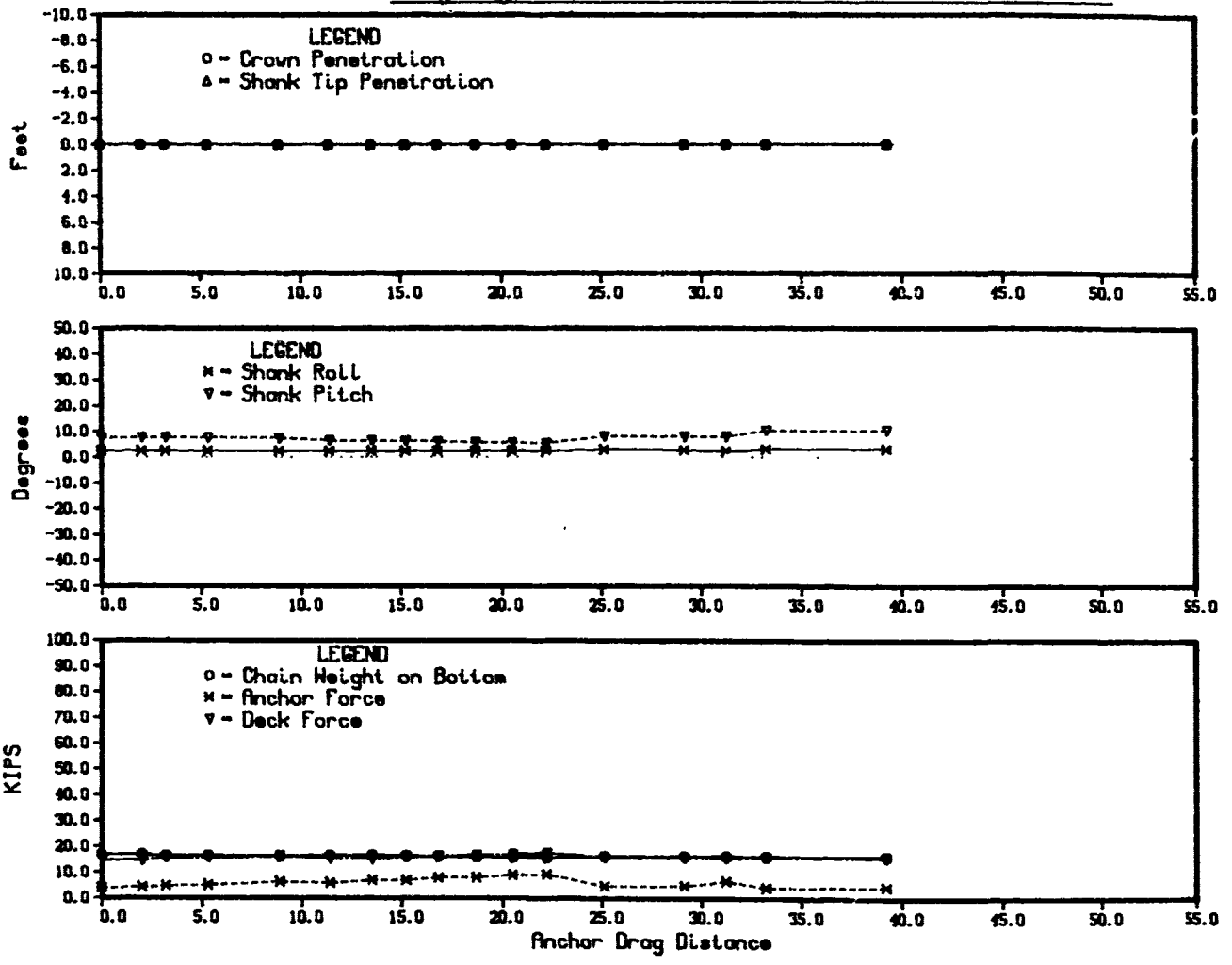
3

Day # = 209
Test No. = 11
Test Series No. = 0

INDIAN ISLAND

stevfix

silty clay



STEVFIX ANCHOR TEST

TEST DATE	209
TEST NO.	11
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1328 - 1338
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	STEVFIX
ANCHOR WEIGHT	11000.00 LB.
FLUKE ANGLE-TYPE,	50.00 DEG. - 0 0=MOV 1=FIX
MOORING LINE DESCRIPTION	90 FT - 3.0 IN CHAIN, 180 FT - 2.0 I
	270 FT - 3.0 IN CHAIN

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13.
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14.
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15.
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	1 FE
0.0	20.9	4.0	*****	2.4	7.5	45.0	14.8	334.7	16901.5	***
2.0	20.8	4.3	*****	2.4	7.5	45.1	14.7	335.4	16946.5	***
3.2	21.9	4.8	*****	2.4	7.5	43.9	15.8	329.1	16494.5	***
5.3	21.8	5.1	*****	2.4	7.5	44.0	15.7	329.7	16536.4	***
8.9	22.5	6.4	*****	2.4	7.3	43.3	16.4	325.7	16249.1	***
11.4	21.6	5.9	*****	2.4	6.4	44.2	15.5	330.9	16621.2	***
13.5	21.5	7.0	*****	2.4	6.4	44.3	15.4	331.4	16664.1	***
15.2	22.0	7.0	*****	2.4	6.3	43.8	15.9	328.5	16452.9	***
16.8	22.6	8.0	*****	2.4	6.0	43.2	16.5	325.2	16215.0	***
18.7	22.8	8.1	*****	2.4	5.7	43.0	16.7	324.1	16136.3	***
20.5	23.1	9.0	*****	2.4	5.5	42.7	17.0	322.5	16017.5	***
22.2	23.6	9.2	*****	2.4	5.4	42.2	17.5	319.7	15818.2	***
25.1	22.0	4.7	*****	2.9	8.0	43.8	15.9	328.7	16466.7	***
29.1	22.0	4.9	*****	2.7	7.9	43.8	15.9	328.7	16463.9	***
31.2	21.9	5.7	*****	2.2	7.9	43.9	15.8	329.1	16494.5	***
33.2	22.1	4.2	*****	3.0	10.2	43.7	16.0	327.8	16400.3	***
39.2	22.1	4.4	*****	3.0	10.2	43.7	16.0	327.8	16400.3	***

DISTANCE BARGE TRAVELLED 40.0
DISTANCE ANCHOR TRAVELLED 39.2

55.0
55.0
55.0

2

FIX ANCHOR TEST

LAND
3R
Y

LB.
. - 0 0=MOV 1=FIX
.0 IN CHAIN, 180 FT - 2.0 IN CHAIN
3.0 IN CHAIN

HAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
HAIN WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
NCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
NCHOR SHANK TIP DEPTH CROWN

8	9	10	11	12	13	14	15
IPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
4.8	334.7	16901.5	*****	*****	*****	85.0	27901.5
4.7	335.4	16946.5	*****	*****	*****	85.0	27946.5
5.8	329.1	16494.5	*****	*****	*****	85.0	27494.5
5.7	329.7	16536.4	*****	*****	*****	85.0	27536.4
6.4	325.7	16249.1	*****	*****	*****	85.0	27249.1
5.5	330.9	16621.2	*****	*****	*****	85.0	27621.2
5.4	331.4	16664.1	*****	*****	*****	85.0	27664.1
5.9	328.5	16452.9	*****	*****	*****	85.0	27452.9
6.5	325.2	16215.0	*****	*****	*****	85.0	27215.0
6.7	324.1	16136.3	*****	*****	*****	85.0	27136.3
7.0	322.5	16017.5	*****	*****	*****	85.0	27017.5
7.5	319.7	15818.2	*****	*****	*****	85.0	26818.2
5.9	328.7	16466.7	*****	*****	*****	85.0	27466.7
5.9	328.7	16463.9	*****	*****	*****	85.0	27463.9
5.8	329.1	16494.5	*****	*****	*****	85.0	27494.5
6.0	327.8	16400.3	*****	*****	*****	85.0	27400.3
6.0	327.8	16400.3	*****	*****	*****	85.0	27400.3

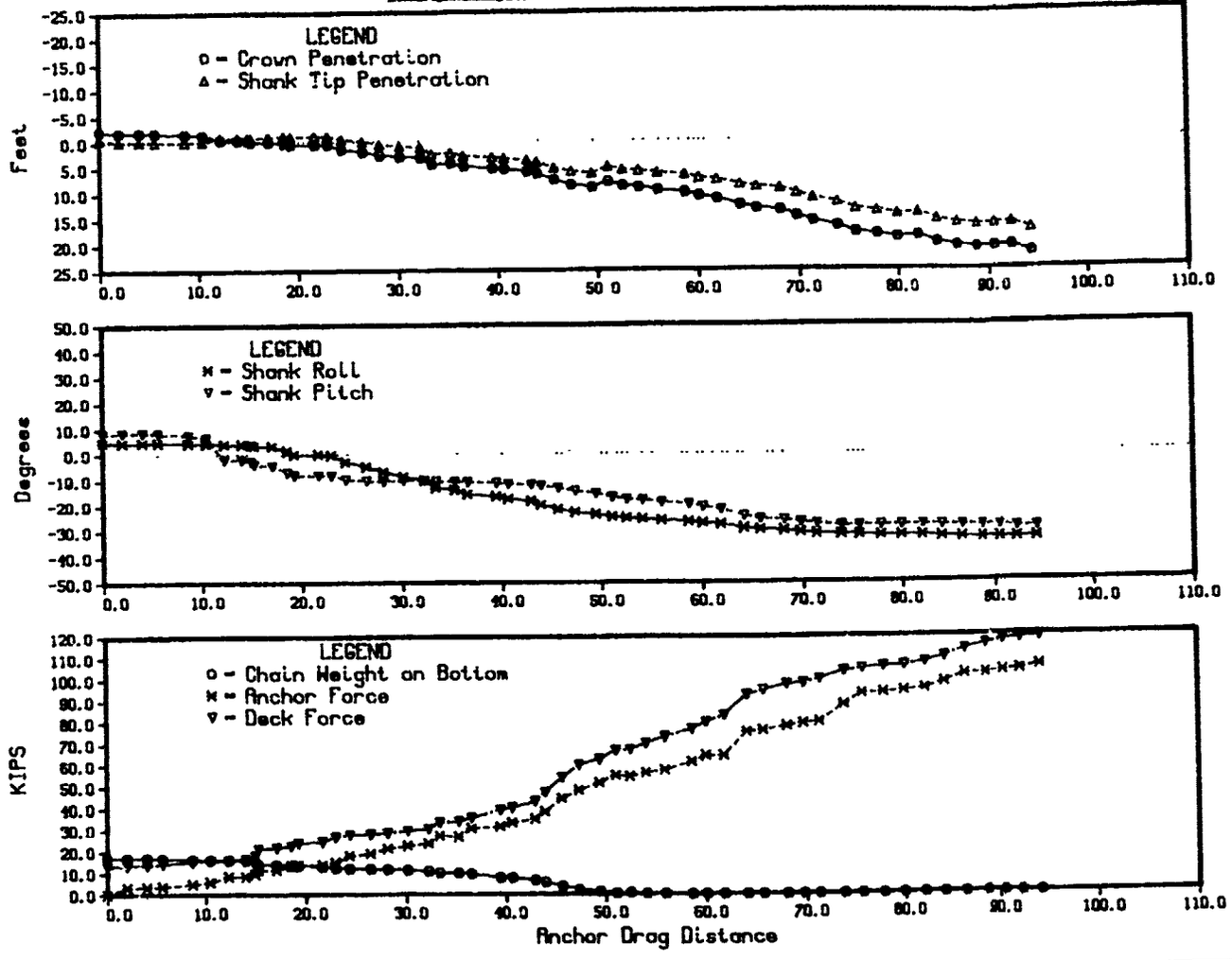
3

Day # - 209
Test No. - 12
Test Series No. - 0

INDIAN ISLAND

stevfix

silty clay



STEVFIX ANCHOR TEST

TEST DATE	209
TEST NO.	12
TEST RUN	0
TEST AREA	INDIAN ISLAND
START-END TIMES	1548 - 1636
SEAFLOOR TYPE	SILTY CLAY
ANCHOR TYPE	STEVFIX
ANCHOR WEIGHT	11000.00 LB.
FLUKE ANGLE-TYPE,	50.00 DEG. - 1 0=MOV 1=FIX
MOORING LINE DESCRIPTION	90 FT - 3.0 IN CHAIN, 180 FT - 2.0 IN 270 FT - 3.0 IN CHAIN

1. DRAG DISTANCE 5. ROTATION ANGLE 9. CHAIN LENGTH ON BOTTOM 13. A
2. DECK TENSION 6. SHANK ANGLE 10. CHAIN WEIGHT ON BOTTOM 14. W
3. ANCHOR TENSION 7. WIRE ROPE ANGLE 11. ANCHOR CROWN DEPTH 15. T
4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH

1 FEET	2 KIPS	3 KIPS	4 FEET	5 DEG	6 DEG	7 DEG	8 KIPS	9 FEET	10 LBS	11 FEET
0.0	19.5	.1	86.1	4.9	8.3	47.5	13.2	340.3	17303.1	85.8
2.0	20.0	3.4	86.4	4.6	8.6	46.9	13.7	337.2	17076.8	86.1
4.0	20.0	3.5	86.4	4.6	8.6	46.9	13.7	337.2	17076.8	86.1
5.6	20.6	3.9	86.5	4.6	8.4	46.2	14.3	333.5	16811.7	86.2
8.6	21.7	5.0	86.7	4.4	7.7	44.9	15.4	327.3	16362.6	86.4
10.4	22.0	6.0	86.8	4.3	6.5	44.6	15.7	325.5	16232.6	86.6
12.2	22.4	8.4	87.5	4.0	-2.0	44.2	16.1	323.1	16063.5	87.5
13.9	22.8	8.3	87.6	4.0	-2.2	43.8	16.5	320.8	15899.1	87.6
14.9	24.3	9.4	87.7	3.8	-2.7	42.3	18.0	312.8	15319.5	87.7
15.2	27.6	11.4	87.8	3.4	-3.9	39.6	21.3	295.6	14079.7	87.9
17.0	28.2	11.5	87.8	3.2	-4.4	39.2	21.8	292.3	13849.1	87.9
18.5	29.0	13.4	88.0	1.4	-6.9	38.0	22.7	288.9	13599.4	88.2
19.2	30.2	13.7	88.3	-.1	-8.0	37.2	24.0	286.2	13404.3	88.5
21.6	31.0	13.7	88.3	-.1	-8.1	37.2	24.7	279.9	12954.7	88.5
22.9	33.0	14.9	88.3	-.4	-8.2	36.0	26.7	270.5	12273.8	88.5
24.3	34.0	17.9	89.1	-3.1	-9.8	35.3	27.7	263.4	12028.0	89.4
26.4	34.5	19.0	89.6	-4.9	-10.2	35.2	28.2	256.5	11807.8	89.9
28.1	35.0	21.3	90.2	-6.9	-10.4	34.8	28.7	252.8	11690.0	90.5
30.1	36.0	22.7	90.6	-8.8	-10.2	34.5	29.7	240.5	11294.6	90.9
32.2	37.0	23.7	90.8	-10.1	-10.2	34.3	30.6	226.4	10845.5	91.1
33.3	40.0	27.2	92.1	-13.1	-10.5	32.9	33.6	109.3	9976.5	92.4
35.2	40.4	26.7	91.9	-14.0	-10.6	32.7	34.0	196.9	9872.1	92.2
36.5	42.0	30.7	92.5	-15.6	-10.8	31.8	35.7	185.7	9541.6	92.8
39.4	46.0	31.5	92.9	-16.6	-11.2	31.3	39.3	130.0	7761.5	93.2
40.6	47.0	33.3	93.1	-17.5	-11.7	30.7	40.4	128.1	7698.6	93.4
42.9	50.0	35.1	93.5	-18.3	-12.0	30.1	43.2	93.4	6589.4	93.8
43.9	54.0	38.4	94.0	-19.9	-12.4	29.8	47.3	78.9	5681.8	94.3
45.6	61.0	44.6	95.2	-21.6	-13.3	27.3	54.2	51.2	3683.5	95.5
47.3	67.0	48.3	96.1	-22.8	-14.5	26.2	60.1	28.9	2078.1	96.5
49.4	70.0	51.8	96.6	-23.6	-15.5	25.8	63.0	16.2	1169.8	97.0
51.0	74.0	55.1	95.5	-24.6	-16.9	25.1	67.0	4.2	300.9	95.9
52.4	74.0	54.6	96.2	-25.1	-17.7	24.8	67.2	8.6	617.1	96.7
54.0	77.0	56.3	96.5	-25.5	-18.1	24.2	70.2	1.6	115.9	97.0
55.9	80.0	57.6	97.1	-26.1	-19.0	23.9	73.2	******	*******	97.6
58.6	84.0	61.5	97.5	-26.6	-19.7	23.7	76.9	******	*******	98.0
60.0	87.0	64.5	98.2	-27.1	-20.7	23.2	80.0	******	*******	98.7
61.8	90.0	64.5	98.7	-27.7	-21.9	22.8	83.0	******	*******	99.3
64.1	100.0	75.4	99.9	-29.2	-24.4	22.0	92.7	******	*******	100.5
65.7	102.0	76.2	100.6	-29.8	-25.7	21.7	94.8	******	*******	101.2
68.1	105.0	78.0	100.9	-30.1	-26.1	21.7	97.6	******	*******	101.5
69.7	105.5	79.3	101.9	-30.8	-26.9	21.4	98.2	******	*******	102.6
71.3	107.0	80.0	102.9	-31.5	-27.7	21.1	99.8	******	*******	103.6
73.8	111.0	87.9	103.8	-31.8	-28.3	21.1	103.6	******	*******	104.5
75.6	112.0	93.1	105.1	-32.0	-28.4	20.9	104.6	******	*******	105.8
77.8	113.0	93.5	105.5	-32.2	-28.3	20.9	105.6	******	*******	106.2
79.9	113.5	94.3	106.1	-32.2	-28.2	21.0	106.0	******	*******	106.8
82.1	115.0	95.2	105.8	-32.3	-28.1	21.0	107.4	******	*******	106.5
84.1	117.5	98.2	107.1	-32.8	-28.3	20.8	109.9	******	*******	107.8
86.3	121.0	101.7	107.8	-33.1	-28.5	20.6	113.2	******	*******	108.5
88.6	123.5	101.9	108.1	-33.3	-28.7	20.6	115.6	******	*******	108.8
90.5	125.0	102.9	108.0	-33.4	-28.9	20.5	117.1	******	*******	108.7
92.3	126.0	103.6	107.9	-33.5	-29.4	20.3	118.1	******	*******	108.6
94.3	126.6	105.3	109.2	-33.5	-29.6	20.3	118.7	******	*******	109.9

DISTANCE BARGE TRAVELLED 106.0
DISTANCE ANCHOR TRAVELLED 94.3

2

FIX ANCHOR TEST

LAND
36
Y

LB.
- 1 0=MOV 1=FIX
.0 IN CHAIN, 180 FT - 2.0 IN CHAIN
3.0 IN CHAIN

CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH NOTE - POSITIVE SHANK
CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH ANGLE INDICATES
ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT SHANK TIP BELOW
ANCHOR SHANK TIP DEPTH CROWN

8	9	10	11	12	13	14	15
KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
13.2	340.3	17303.1	85.8	87.4	91.0	88.0	28303.1
13.7	337.2	17076.8	86.1	87.8	91.3	88.0	28076.8
13.7	337.2	17076.8	86.1	87.8	91.3	88.0	28076.8
14.3	333.5	16911.7	86.2	87.9	91.4	88.0	27811.7
15.4	327.3	16362.6	86.4	87.9	91.6	88.0	27362.6
15.7	325.5	16232.6	86.6	87.8	91.6	88.0	27232.6
16.1	323.1	16063.5	87.5	87.1	92.0	88.0	27063.5
16.5	320.8	15899.1	87.6	87.2	92.1	88.0	26899.1
18.0	312.8	15319.5	87.7	87.2	92.2	88.0	26319.5
21.3	295.6	14079.7	87.9	87.1	92.2	88.0	25079.7
21.8	292.3	13849.1	87.9	87.0	92.2	88.0	24849.1
22.7	288.9	13599.4	88.2	86.8	92.3	88.0	24599.4
24.0	286.2	13404.3	88.5	86.9	92.6	88.0	24404.3
24.7	279.9	12954.7	88.5	86.9	92.6	88.0	23954.7
26.7	270.5	12273.8	88.5	86.9	92.5	88.0	23273.8
27.7	263.4	12028.0	89.4	87.5	93.3	88.0	23028.0
28.2	256.5	11807.8	89.9	87.9	93.7	88.0	22807.8
29.7	252.8	11690.0	90.5	88.5	94.3	88.0	22690.0
29.7	240.5	11294.6	90.9	88.9	94.7	88.0	22294.6
30.6	226.4	10845.5	91.1	89.1	94.9	88.0	21845.5
33.6	199.3	9976.5	92.4	90.4	96.1	88.0	20976.5
34.0	196.0	9872.1	92.2	90.2	95.9	88.0	20872.1
35.7	185.7	9541.6	92.8	90.8	96.5	88.0	20541.6
39.3	130.0	7761.5	93.2	91.1	96.8	88.0	18761.5
40.4	128.1	7698.6	93.4	91.3	97.0	88.0	18698.6
43.2	93.4	6589.4	93.8	91.6	97.4	88.0	17589.4
47.3	78.9	5681.8	94.3	92.1	97.8	88.0	16681.8
54.2	51.2	3683.5	95.5	93.2	98.9	88.0	14683.5
60.1	28.9	2078.1	96.5	93.9	99.7	88.0	13078.1
63.0	16.2	1169.8	97.0	94.3	100.2	88.0	12169.8
67.0	4.2	300.9	95.9	93.0	99.0	88.0	11300.9
67.2	8.6	617.1	96.7	93.6	99.6	88.0	11617.1
70.2	1.6	115.9	97.0	93.8	99.9	88.0	11115.9
73.2	******	*******	97.6	94.3	100.4	88.0	10332.5
76.9	******	*******	98.0	94.6	100.7	88.0	8862.7
80.0	******	*******	98.7	95.2	101.4	88.0	8476.8
83.0	******	*******	99.3	95.6	101.8	88.0	7847.0
92.7	******	*******	100.5	96.5	102.8	88.0	5170.8
94.8	******	*******	101.2	97.0	103.4	88.0	5032.0
97.6	******	*******	101.5	97.3	103.7	88.0	3924.7
98.2	******	*******	102.6	98.2	104.6	88.0	4185.5
99.8	******	*******	103.6	99.2	105.5	88.0	4142.9
03.6	******	*******	104.5	100.0	106.4	88.0	2756.5
04.6	******	*******	105.8	101.3	107.7	88.0	2743.6
05.6	******	*******	106.2	101.7	108.1	88.0	2350.2
06.0	******	*******	106.8	102.3	108.7	88.0	2097.7
07.4	******	*******	106.5	102.0	108.4	88.0	1542.6
09.9	******	*******	107.8	103.3	109.7	88.0	1031.6
13.2	******	*******	108.5	104.0	110.4	88.0	28.1
15.6	******	*******	108.8	104.3	110.6	88.0	-812.8
17.1	******	*******	108.7	104.2	110.5	88.0	-1116.4
18.1	******	*******	108.6	104.1	110.4	88.0	-1116.4
18.7	******	*******	109.9	105.3	111.7	88.0	-1324.9

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